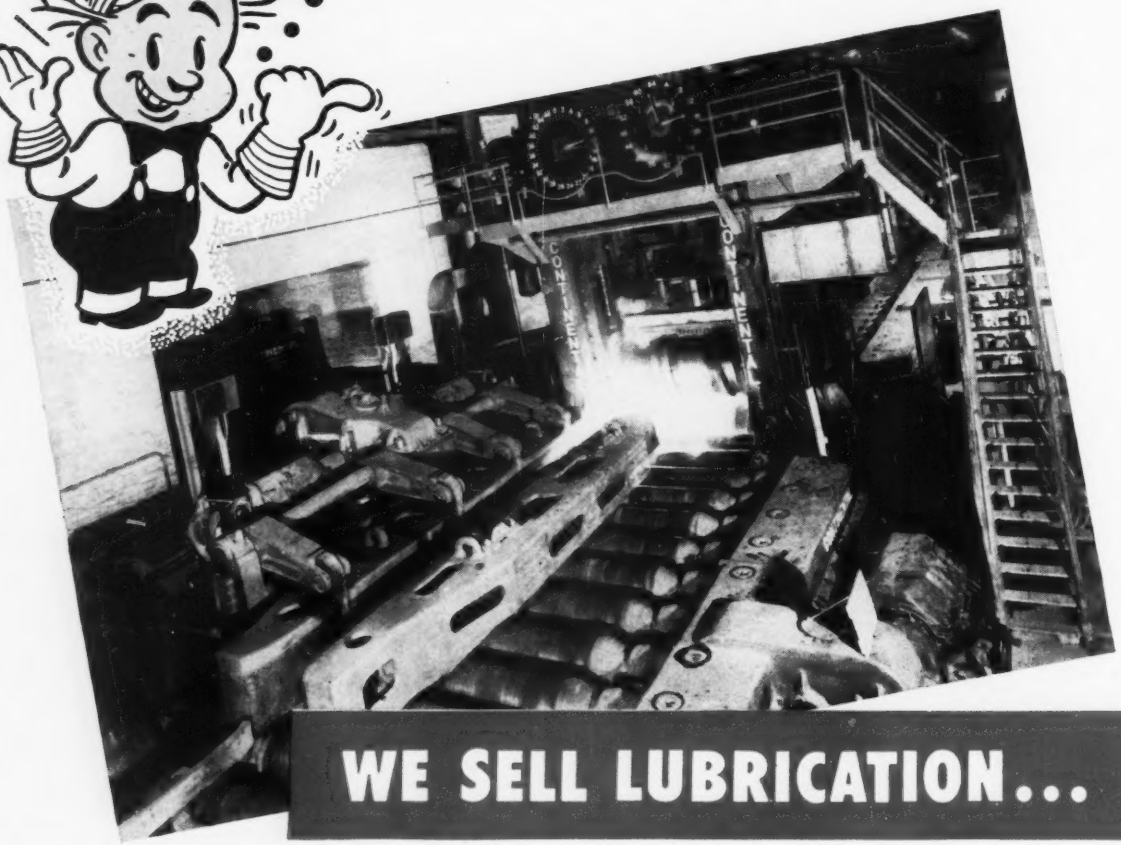
Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

"THERE ARE MORE *Trabon* AUTOMATIC LUBRICATING SYSTEMS IN OPERATION THAN ALL OTHER MAKES!"



WE SELL LUBRICATION...

Which means Trabon customers get a lubricating system which—day after day, month after month, and year after year—properly lubricates your bearings, with a minimum of down time and maintenance.

No shutdowns for bearing failure . . . no work stoppage for lubrication . . . Trabon lubricates as your machines produce . . . delivers the right amount of lubricant to each bearing.

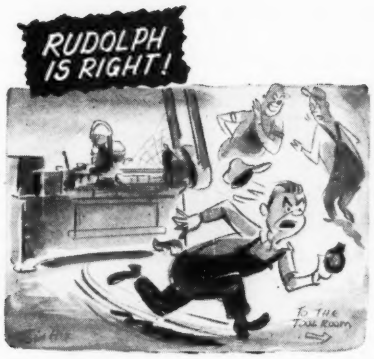
Trabon oil and grease systems operate in heat and cold; in high or low places . . . in dirt, dust, ice, water, grime; withstand vibration and pounding.

Repeat orders from old customers prove the merit of Trabon. Trabon Lubricating Systems are your insurance against costly down time, bearing failures and lost production.

Trabon

OIL AND GREASE SYSTEMS

TRABON ENGINEERING CORPORATION
1814 East 40th Street • Cleveland 3, Ohio



"Using the Right Cutting Fluid Would Eliminate a Lot of Time and Money Wasted Changing Cutters"

There are literally thousands of examples to prove how the right application of the *right* cutting fluid can make a tremendous difference in machining efficiency. Here is another one which will help you realize the opportunities afforded by an open-minded look at your cutting fluids:

• **THE JOB:** Generator machining a 1" dia. worm gear, double thread.

COMPARISON OF CUTTING FLUID PERFORMANCE

	Previous Oil	Stuart's THREDKUT
Production per grind/dress	20 pieces average	190 pieces average
Finish	Passable	Satisfactory
Oil dilution	None	4 to 1
Cost of oil on machine	42c/ gal.	27.2c/gal.
Downtime during test	2½ hours	None

Think of the increase in cutter life (cost about $86.90 each). Before using Stuart's ThredKut they were reground 9½ times as often. Add to this the saving in downtime and the saving in cutting fluid price and you'll see why "Rudolph is Right."

Write for your copy of Stuart's Shop Notebook—a bi-monthly publication devoted to the selection and application of metal-working lubricants.

GET MORE PRODUCTION
Use The Right Cutting Fluid

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Offices in Principal Industrial Centers

D.A. Stuart Oil CO.
2729-53 S. Troy St., Chicago 23, Ill.

Lubrication ENGINEERING

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THEY CORRECTLY LUBRICATE EACH POINT
Separate pumping units for each wearing point.

THEY LENGTHEN THE LIFE OF MACHINERY
Perfectly engineered lubrication adds years of trouble free service.

THEY REDUCE "DOWN TIME"
Machinery is lubricated while in operation.

THEY CUT OIL CONSUMPTION DRASTICALLY
Accurate metering of oil saves up to 90%.

THEY PUMP AGAINST HIGH PRESSURES
Special models available for most requirements.

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Manzel Force Feed Lubricators are furnished as standard equipment on many of the leading makes of presses, engines, and other machinery. Or they can be installed on your present equipment. They may be synchronized by lever or rotary drive, or operated by a separate electric motor.

We will gladly have a Manzel lubrication engineer submit recommendations without obligation. Just write...

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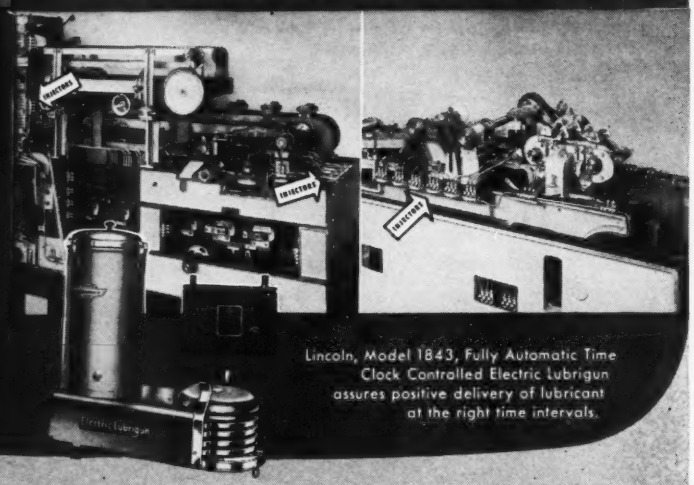
"there has been no lost production due to improper lubrication since installing *Lincoln's* centralized lubrication system"

Mr. Frank Willbrandt
Chief Engineering Packaging Division
Battle Creek Bread Wrapping Machine Co.
Battle Creek, Michigan

View of high-speed carton making, filling and top-sealing machine equipped with Lincoln's Centralized Lubrication System.

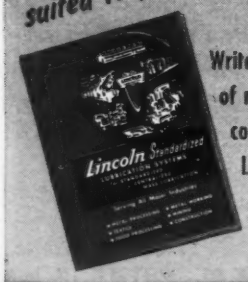
ON OLD OR NEW EQUIPMENT, *Lincoln's* CENTRALIZED LUBRICATION SYSTEMS

APPLY THE RIGHT LUBRICANT IN THE RIGHT QUANTITY AT THE RIGHT TIME



Lincoln, Model 1843, Fully Automatic Time Clock Controlled Electric Lubrigun assures positive delivery of lubricant at the right time intervals.

Lincoln's Lubrication System specialists will work with you and recommend the time and money-saving Centralized Lubrication System best suited to your equipment.



Write for your **FREE** copy of new catalog giving complete information on Lincoln's Centralized Lubricating Systems.

"As a result of the use of Lincoln's Centralized Lubrication System on high-speed carton making, filling and top-sealing machines, there has been no lost production due to improper lubrication. Previously, similar machines, operating without the Centralized System, were frequently out of production, due to bearing failures caused by lack of lubricant.

"We find Lincoln's Centralized Lubrication System very reliable, as well as flexible, for varying operating conditions at different points on the machines."

F. M. Willbrandt
Chief Engineering Packaging Division
Battle Creek Bread Wrapping Machine Co.
Battle Creek, Michigan

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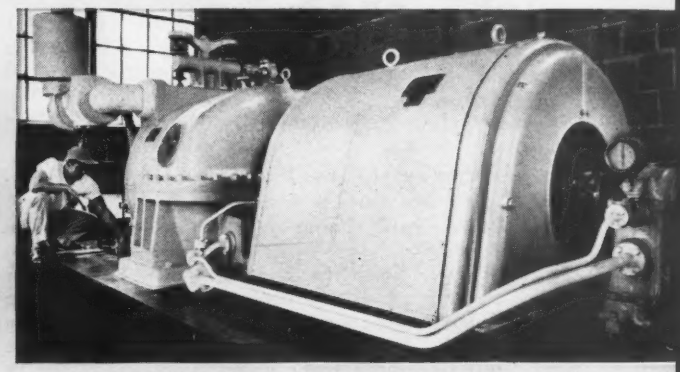
LINCOLN
LUBRICATING EQUIPMENT • • •

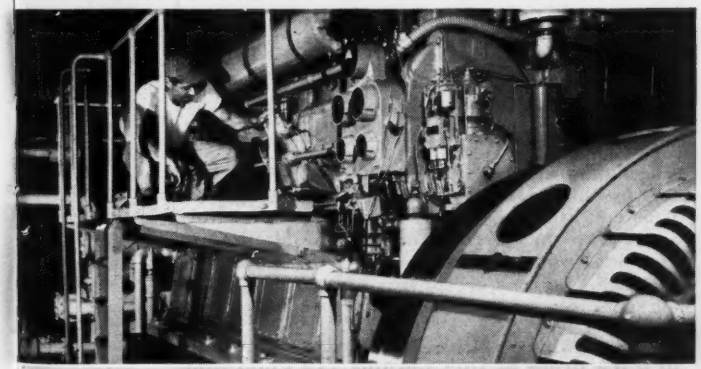
NANTUCKET ISLAND can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

HOW SUN PROTECTS NANTUCKET'S POWER

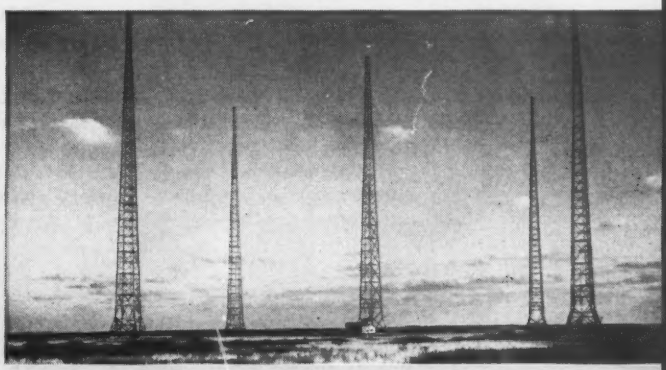
THE ISLAND'S POPULATION drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



DESPITE IDLENESS for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



A SUN DIESEL LUBRICANT has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



POWER for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. LE12

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DOW CORNING

Silicone Notes

ON LUBRICATION

REFERENCE NO. SL-51

FILE SILICONE LUBRICANTS

Make sure you have basic data sheets BG-2, 5502, 7101. If misplaced write Department BW-12

DOW CORNING CORPORATION
Midland, Michigan

DOW CORNING 44 GREASE

791 HOURS AT 400°F. plus 2033 hours of operation at 300°F. were ticked off before we reached an end point in testing bearings lubricated with Dow Corning 44 Silicone Grease. We used heat-treated, steel retainer bearings operating at 1750 rpm under a spring load of 150 pounds. After 250 eight-hour days at 300°F., we pushed the temperature up to 400. 791 hours later the bearing failed. That's at least 10 times the maximum life recorded for any organic grease tested at 400°F.

AFTER 754 HOURS at 390, 365 and 330°F. respectively, the life testing of Dow Corning 44 Grease in 3 similar bearings operating at the same speed under the same load was discontinued. Only the 390° bearing showed sign of failure. Under the same conditions, other bearings were operated at 385°F. for 814 hours and at 390°F. for 774 hours. The bearings were just beginning to be noisy.

RESULTS OF OUR LIFE TESTING at 350-400°F. have been confirmed by independent investigators. We feel justified, therefore, in raising the maximum operating temperature suggested for Dow Corning 44 Silicone Grease from 350 to 400°F. Maximum speed factor (mm. bore x rpm) remains at 150,000-225,000.

ANNEALING OVENS AT 1400°F. are located only 2 feet from bearings on motor directly coupled to forced draft fans. In spite of frequent relubrication with organic greases these bearings had a service life of about 6 months. The electrical foreman finally installed bearings prelubricated with Dow Corning 44 Grease. These bearings have never been relubricated and they are still in service after about 2 years of operation.

DOW CORNING SILICONE OILS

METAL COMBINATIONS now commonly used in bearings were developed to give maximum service with conventional lubricants. They are the result of years of Edisonian research. Yet many people assume that the lubricant is incidental; expect a synthetic lubricant to perform equally well between metals carefully selected for use with petroleum oils of radically different chemical structure. That's a fallacy that may lead to trouble in the use of synthetic lubricants, including our silicone oils and greases.

RELATIVELY CONSTANT VISCOSITY over a wide temperature span, exceptional heat stability and oxidation resistance are properties peculiar to our silicone fluids. And those are among the properties required of an ideal lubricant. The ability to reduce wear and friction is the other basic property and that depends in large measure on the metal combinations. Here's some data on the relative effectiveness of various silicone fluids as lubricants for various metal combinations.

METAL COMBINATION	*Dow Corning 200*	*Dow Corning 550*	*Dow Corning 710*
Cast iron—bronze	Good	Good	Good
Cast iron—steel	Poor	Poor	Poor
Bronze—nylon	Good	Good	Good
Steel—aluminum	Poor	Poor	Poor
Steel—babbitt	Good	Poor	Poor
Steel—bronze	Good	Good	Poor
Steel—cadmium	Good	Good	Good
Steel—chrome	VARIABLE RESULTS		
Steel—nylon	Good	Good	Good
Steel—steel	Poor	Poor	Poor
Steel—zinc	Good	Good	Good

These data were obtained with a Falex lubricant test machine under boundary or extreme pressure conditions. They are presented here only as a guide in selecting metal combinations to give maximum life with various Dow Corning Silicone Fluids. Careful breaking-in of bearing surfaces may be required.

TWO YEARS vs. 36 HOURS. That's the relative life of a few drops of Dow Corning 710 Fluid compared with any other lubricant tested in a clock motor fully exposed to the atmosphere.

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

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Lighter Gauges?
Higher Speeds?

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MORGOIL Bearings are helping to solve these difficulties by the accuracy and precision of their manufacture, absence of wear between journal and bearing, and the maintenance of uniform roll neck temperatures.

Evidence of this fact is the ever increasing use of MORGOILS on 2-High and 4-High aluminum foil mills and 4-High reversing and tandem cold mills in the brass and steel industries.

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HOW TO PUT YOUR PLANT *in the Pink*

If your plant is suffering from painfully high metal cutting costs, prescribe CIMCOOL°. . . and watch the profit figures and working picture take on a rosy hue. This radically new and different cutting fluid—this *chemical emulsion*—saves you money three important ways:

℞ CIMCOOL INCREASES TOOL LIFE (and thus reduces down time) because of its chemical lubricity.

℞ FASTER SPEEDS are possible because Cimcool cools faster, through a unique physical change in the cutting fluid itself. Tools and chips actually stay cool to the touch.

℞ CIMCOOL COSTS LESS than old-fashioned cutting fluids because it lasts longer, cuts labor costs for cleaning and changing. It virtually eliminates rancidity and foul odors. Because of its low surface tension and low adhesion to work and chips, there is practically no carry off.

We honestly believe that a week's run will convince you. And we'll be happy to provide a demonstration in one of your own machines. Just write us and we'll have one of our Cincinnati Milling-trained machinists call on you—without cost or obligation. Or, if you prefer, write for our free booklet "CIMCOOL Gives the Answers." Address, Sales Manager, Cincinnati Milling Products Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.

°Trade Mark Reg. U.S. Pat Off.

A Production-Proved Product of
THE CINCINNATI MILLING MACHINE CO.

for **85%**
OF ALL METAL CUTTING JOBS

you won't go wrong on

High Temperature Lubrication

when you select the proper HI-TEMP OIL

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Houghton's series of Hi-Temp Oils give you a safe, sure choice of hot spot lubricants. No guessing. Each is designed for particular operating temperature ranges to over 500° F., based on more than 300 actual operating tests.

2 REDUCE DOWNTIME!

Hi-Temp's clean, dependable lubrication keeps production going. Costly downtime due to inadequate lubrication is no problem to Hi-Temp users.

3 CUT MAINTENANCE COSTS!

Pick the right Hi-Temp Oil for any lubrication job and it will out-last, out-perform ordinary oils.

HI-TEMP 100 Series—High-viscosity, low-carbon mineral oils applied by conventional methods.

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HI-TEMP 103 —Rec. from 450° to 500° F.

HI-TEMP 200 Series—Light oils reinforced with synthetic organic compounds. Adaptable to use in automatic spray-type lubricators.

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HI-TEMP 237 —Rec. from 450° to 500° F.

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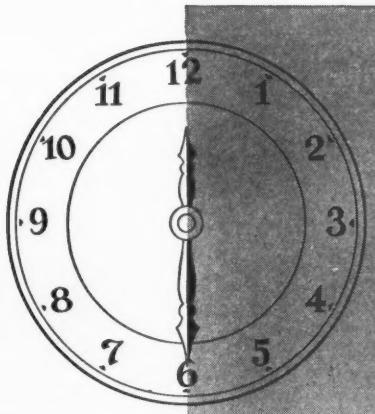

...for the half-hour that wasn't there

WHEN a Massachusetts company* surveyed their plant methods, they were amazed to find how much it was actually costing them to keep their machinery lubricated.

The lubrication cost was $14 every day. Added to that was the cost of the half-hour's production time lost every day while the machinery was stopped for lubrication.

This manufacturer called in an Alemite Lubrication Engineer. He recommended a system that *automatically* lubricated all the machinery . . . while it was running! The result: the lost half-hour was converted to productive time and the cost of lubrication was cut from $14 a day to only 21c a day. The total savings are over $3,000 every year.

Call Your Alemite Lubrication Engineer

No matter what size or type of plant you operate, Alemite can show you dozens of ways to save through the more efficient handling of petroleum products. Call your local Alemite Industrial Distributor now or send for the free booklet "11 Ways to Cut Production Costs." Simply attach the coupon below to your letterhead. Dept. P-121, 1850 Diversey Parkway, Chicago 14, Ill. *Name on request*

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1. Methods 2. Lubricants 3. Equipment

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2. In loading grease guns . . . saves 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.

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FREE! Valuable Booklet—

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We'll include facts on the new Alemite Oil-Mist System, too—(OIL-MIST atomizes oil into mist, circulates it to bearings under pressure. Increases life of bearings as much as 17½ times).

*Name*_____

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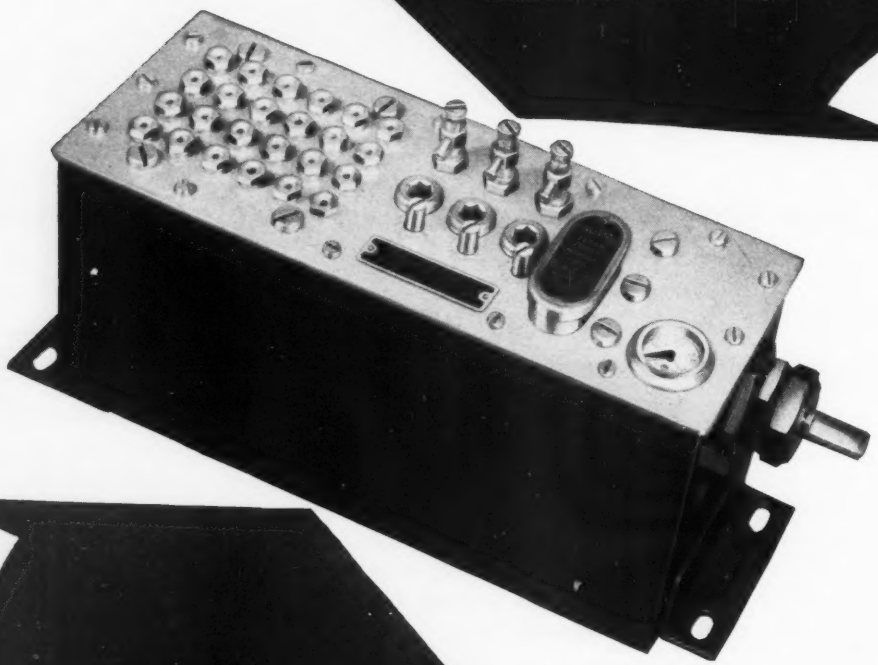
Fresh Oil LUBRICATORS



THE MOST DEPENDABLE OILING SYSTEM EVER DEVELOPED!

MEASURED FEED DROP BY DROP FED UNDER PRESSURE!

MACHINE performance is in direct relation to the quality of the oiling system! And that's why builders of America's finest machine tools, work engines and compressors specify Madison-Kipp "Fresh Oil" Lubricators as original standard equipment . . . because they provide the most dependable oiling system ever developed . . . measured feed, drop by drop, fed under pressure. There are six models to meet almost every application requirement. Illustrated is the Model FD. Please address all inquiries to the home office in Madison, Wisconsin

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Lube Lines

Bi-Monthly

The question is often asked why a journal that has risen so rapidly and reached such a firm position of authority and usefulness should continue to limit itself to bi-monthly publication. Why is it not issued once a month like the journals of most of the other professional societies? Doesn't it have enough material for twelve issues a year? Doesn't it have sufficient editorial staff? We feel that these questions in the minds of our members and readers should be answered.

The inferences behind the above questions are not correct. As a matter of fact we could develop enough material for an issue every month and we would have the staff to handle it. Our reason for this action is, on the contrary, quite definite and positive and it is as follows:

In conversation with many of our members who are leading figures in either the industrial or technical fields of lubrication, we are told more and more of the impossibility of getting through the ever-increasing volume of published material that comes across their desk. These people say that what they need is not a greater volume of material but more sifting and digesting of available information so that they have brought to their attention only the important and significant developments and contributions. "A busy man just simply cannot wade through all this reading matter and get something out of it and at the same time get his day's work done."

Therefore, the editors of LUBRICATION ENGINEERING have concluded that they can be of greatest service to their readers by doing some of this sifting for them and by giving you out of the total volume available only the really important material, thereby recommending it to your serious attention. We could publish a monthly issue the average content value of which would compare favorably with other professional journals but instead we are selecting only the most valuable and important portions. The articles and features that result are suited to a bi-monthly publication.

We have made the above decision through a desire to serve you best; thus we conserve your time and bring to you the most pertinent facts related to the field of lubrication.

Memo to Our Readers

In view of the fact that the number of our readers is constantly increasing we desire to bring to the attention of our more recently acquired readership the Society publications available.

Wear and Lubrication of Piston Rings and Cylinders, by Dr. Reemt Poppinga. This is a translation of the complete results of a research program to investigate the problem of wear in all of its ramifications.

The research was conducted at the University of Dresden and the manuscript was translated from the original German by Dr. Edmund Kurz, Queens College, New York, with Dr. D. D. Fuller, Columbia University, as technical adviser.

Chapter headings selected at random: Considerations Concerning Wear—The Investigation of Material Structure Upon Wear—The Investigation of the Influence of the Lubricant Upon Wear.

A total of 636 references are cited with 74 diagrams and curves included.

A hard cover book, attractively bound in green cloth with gold stamping, priced at $3.00 to ASLE members and $3.50 to non-members.

A publication program was designed to make available in convenient form fundamental knowledge on lubrication. The work has been conducted under the general supervision of the Education Committee.

In lubrication, as in many fields of scientific endeavor, the capacities for development and research have frequently outstripped the means for coordination and assimilation of the information that is revealed. This situation often leads to considerable confusion and dissatisfaction. It is the aim of the American Society of Lubrication Engineers to clarify this picture as much as possible, as far as lubrication is concerned, and provide accurate and complete surveys of the basic phenomena of lubrication.

To date two monographs have been completed. They are bound in stiff paper in convenient size, 5½"x8½", priced at $1.00 per copy.

Physical Properties of Lubricants (Second Printing—Revised Edition). Topical headings include: Viscosity—Density and Specific Gravity—Cloud and Pour Points—Flash and Fire Points—Carbon Residue—Neutralization Number and Interfacial Tension—Saponification Number—Emulsification—Specific Heat. Pertinent charts, graphs and equations together with a bibliography complete the work.

Petroleum-Type Hydraulic Fluids (A special publication in the interest of better lubrication). This was issued as the result of an awakening interest on the part of users of hydraulically-operated machinery and their growing desire to learn more about the action of petroleum-type oils in this type of industrial equipment.

Topical headings include: Hydraulic Oil Specifications and Service Properties—Viscosity—Viscosity Index—Demulsibility—Oxidation Stability—Lubricating Value—Rust and Corrosion Preventive Qualities. The text is accompanied by appropriate illustrations.

NUMBER 7

DISPENSING EQUIPMENT*

by E. J. Gesdorf

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Mr. Gesdorf attended Fenn College and Case Institute of Technology.
In 1932 he became associated with the Farval Corporation and engaged in the manufacturing and testing of centralized lubricating equipment. After obtaining a broad inside knowledge of the Company's products, he was transferred to the Installation Department and spent many years in the field supervising the installation of Farval Centralized Lubricating Systems in all types of industries, both in this country and in foreign countries.
At present, Mr. Gesdorf is working on special engineering assignments.

All about us today are machines of every conceivable description—some large, some small, some complicated, some simple. All are working to produce goods for the American standard of living or working to protect that standard of living—yet without lubrication in some form these machines would quickly grind to a halt and be reduced to a worthless heap.

It is obvious that to obtain effective lubrication of any piece of equipment, it is necessary to have a suitable method of applying the lubricant to the proper points in proportion to the demand. Considerable thought has been given to methods of handling and applying lubricants and as evidence of this fact, the catalogs of the various lubricating dispensing equipment manufacturers would fill a good sized bookcase.

Before selecting lubricating equipment for a particular application, a careful study of the lubrication requirements and operating conditions of the machine should be made so that the most suitable dispensing device available can be employed to do the job. A wise selection of equipment should produce the following essential advantages:

1. Promote continous high speed machine operation.
2. Insure positive lubrication of every bearing.
3. Eliminate personal injury hazards.
4. Prevent over or under lubrication.
5. Save lubrication time.
6. Eliminate lubricant contamination.
7. Reduce repairs and prolong machine life.
8. Increase productive output.
9. Reduce operating costs.

Many machines are equipped with several types of lubricant dispensing devices to satisfy the individual needs of the various component parts. In selecting equipment consideration should be given to the principles of operation, as well as the design and construction of the equipment. Lubricant dispensing equipment is no different than other equipment when a choice of brand has to be made, and the purchaser or user must acquaint himself with the various products and the important points for evaluating merit.

This paper will attempt to give you a cross-section of the lubrication devices available today. No attempt will be made at comparing the relative merits of competitive equipment, as this would require special treatment and not within the scope of this paper.

In general, lubricant dispensing equipment can be grouped under eight headings as follows:

1. Simple oiling devices.
2. Simple greasing devices.
3. Air line lubricators, mist lubricators.
4. Oil and grease spraying equipment.
5. Mechanical forced-feed lubricators.
6. Circulating oil systems.
7. Centralized systems of lubrication.
8. Lubricant handling and transfer equipment.

This grouping will be followed in discussing the subject—

Simple Oiling Devices

Hand Oiling

The simplest of all oiling devices is perhaps the oil can. Oil holes are provided on the machine which lead to bearing surfaces or other machine parts and lubrication is accomplished by squirting oil into the various oil holes. This method of oiling is neither reliable or efficient and usually results in over or under lubrication. Furthermore, dirt often finds its way to a bearing surface to cause damage, as it is almost impossible to keep the oil holes and oil can spout free from contamination.

* Sponsored by ASLE Technical Committee on Lubrication Economics.

Drop Feed Oilers

There are many types of drop feed oilers and the most common is the one having a glass reservoir body with a shutoff and needle valve adjustment controlled by a knurled thumb screw. The oil drips through an adjustable orifice and the drops can be observed and counted through a sight glass. This is an improvement over the squirt can and is used for plain and anti-friction bearings, chain drives, gears, etc., where lubricant consumption is not high and expensive lubricants are not used. This device also has its limitations. The drops per minute are affected by changes in oil level and oil temperature in the reservoir; the orifice may plug with dirt or foreign material; considerable attention is required to prevent reservoir from running dry. If not turned off when machine is stopped, lubricant will continue to drip and result in waste.

Constant Level Lubricators

This lubricator was developed primarily to maintain a predetermined level in a ring oiled or chain oiled journal bearing where moderate speed and load conditions exist, although it has also been used on ball and roller bearings. It operates on a liquid seal principle so that if the oil in the reservoir of the bearing reaches the low level, the liquid seal is broken and air enters the oiler which creates a pressure and causes oil to flow. When the proper oil level in the bearing reservoir is reached, the liquid seal is re-established and the flow of oil from the lubricator is stopped.

Thermal Lubricators

A drop feed oiler which is sensitive to the slightest temperature variations of a bearing is used occasionally. A change in bearing temperature is transmitted to the air above the oil in the reservoir and causes the air to either expand or contract which results in forcing oil flow or stopping oil flow through the control valve.

Bottle Oilers

These oilers are very simple in construction and operation and consist chiefly of an inverted glass bottle reservoir with threaded neck which screws into a metal base having a closely fitted metal vibrating spindle. The metal base is made with a shank to fit into a pipe nipple or into a drilled hole in the bearing cap allowing the end of the vibrating spindle to rest on the journal or shaft. The inverted bottle is air-tight, except for the spindle clearance, oil cannot leak out unless air can enter. When the journal is in operation, the spindle transmits heat from the bearing to the air above the oil in the bottle, and at the same time the spindle receives a slight oscillating vibration from the bearing shaft. The pressure of the expanded air combined with a minute pumping action of the vibrating pin causes oil to flow slowly down the spindle to the journal.

Bottle oilers give a very slow but uniform rate of flow and their application is confined strictly to horizontal bearings. They are not recommended for bearings exposed to extreme temperature variations, traveling or moving bearings, or bearings exposed to severe shock conditions.

Wick-Feed Oilers

These oilers employ the simple principle of syphoning by capillary action. The construction usually centers around a reservoir, center tube, and a wick. The action is similar to that of the wick in an alcohol or kerosene lamp. The starting and stopping of the lubricant flow to the bearing is accomplished by raising or lowering the end of the wick or by turning a shutoff cock. Rate of oil feed can be regulated by the number of strands used in the wick, although variation in oil level and temperature will also influence oil delivery to the bearing. Wool wicks of loose texture and long fibre retain their rate of feed longer than wicks of any other fibrous material, but even the wool wicks should be changed when they become choked with impurities.

The outstanding feature of this type oiler is that it acts as a filter and will feed only clean oil to the bearing. Wick feed oilers are not suitable for equipment running intermittently or exposed to wide temperature variations.

Simple Greasing Devices

There are many conditions in industry that make grease more desirable than oil as a lubricant. The bearings may be operating under intense pressure, high temperature or low speed. When positive lubrication must be assured over extended periods with little attention, grease is usually employed. There are many methods of handling and dispensing greases to industrial machinery.

Hand Application

This method is rapidly disappearing from general use. The paddle, brush or swab used for applying lubricants to open gears, chains and cables, is perhaps the most wasteful method of dispensing lubricants. Recent developments in devices for spraying lubricants will do much to eliminate the hand method of application.

Grease Cups

A great variety of grease cups have been designed but all of them fall into two fundamental classifications —the plain compression type or the spring compression type. The plain compression threaded cap type cup connects directly to the bearing and consists of a cup which holds the grease and screws into the male component. As the cap is screwed down the lubricant is forced through a hole in the stem which is attached to the bearing. This method of delivery is not uniform or efficient and relies mainly on the human element. To overcome some of the limitations of the compression type grease cup, the spring feed cup was designed. Grease is fed slowly from the reservoir by a spring actuated cup leather plunger through a variable orifice or control valve to the bearing. The variable orifice is a

compensating device to offset reduced spring tension as the spring expands and thereby making possible constant delivery. As the spring tension is lowered, the orifice becomes larger. An illustration of a spring compression grease cup is shown in "A" of figure 1.

Grease cups should not be used where wide variations in temperature are encountered.

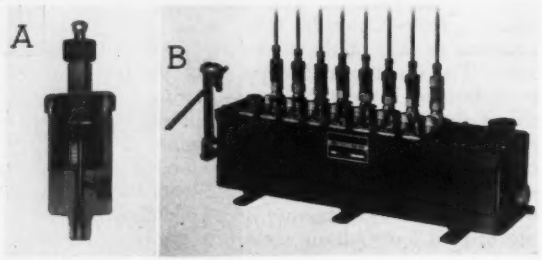

Fig. 1

A–Spring Compression Grease Cup
B–Typical Oil Force-Feed Lubricator

1B(Courtesy McCord Corp.)

Grease Fittings and Hand Guns

There are a host of grease fittings on the market today and almost all of them are designed to include some form of check valve. The most popular of these are identified as: hydraulic, pin type, button head, dot and flush type. The chief difference in the fittings is the method of attaching the grease gun. Each of the fittings is made in various combinations of threads, angles and extensions to suit the multitude of field applications. Wherever possible, grease fittings of one particular type should be standardized throughout a plant. This will make it possible to standardize on the hand guns and gun connections.

Special purpose grease fittings are also in supply. Some of these employ a means of protecting the seals of totally enclosed bearings and will bleed grease through a pressure relief valve or through a milled slot should excessive pressure be developed in the bearing during or after the lubrication period. The three most popular hand grease guns used in connection with grease fittings are the screw-type gun, the push gun, and the lever gun. Grease from a screw-type gun is delivered under pressure simply by turning the "T" handle. The turning action forces a cup leather plunger against the lubricant causing it to open a check valve and leave the gun. Pressures as high as 2000 psi can be developed. The push type gun is operated by placing the nozzle of the gun against the grease fitting and exerting a pushing force on the handle. The pressure of the piston in the body of the gun forces grease into the delivery tube, and the compression of this tube forces grease into the bearing. This gun easily develops high pressure up to 10,000 psi. The lever type gun is actually a small positive displacement pump and a movement of the hand lever causes a piston to reciprocate in a bore, forcing grease out through a discharge check on the inward stroke and reloading the compression chamber on the outward stroke. Lever guns are available for high pressure (up to 10,000 psi) or can be supplied with a large diameter piston for volume delivery at pressures up to 2000 psi.

The guns can be purchased with loader fittings for filling from portable or stationary loader pumps. This arrangement is especially practical as the possibility of air pockets and contamination of lubricant commonly resulting from hand and paddle filling of guns is eliminated.

Figure 2 illustrates typical grease fittings (items 1, 2, 3, 4 and 5), and typical hand guns (items 8, 9 and 10).

Fig. 2

(Courtesy Aro Equipment Corp.)

Air Line Lubricators, Mist Lubricators

Using air-borne oil fog for the lubrication of certain types of equipment has been practiced for many years. This method of lubrication continues in importance and attempts are now being made to broaden the use of air as a carrier agent for lubricants, with the thought of lubricating various types of bearings as well as gearing.

Air Line Lubricators

The primary function of this lubricator is to provide automatic lubrication for air-operated tools, cylinders and equipment by means of a regulated air-borne oil fog. Automatic operation is achieved by use of the venturi principle with conservative air flow and low-pressure drop. Design features include a glass or metal bowl, syphon tube, adjustable needle valve, and sight glass. Transparent bowls are recommended for use with air pressure up to 125 psi, and ambient temperatures up to 120 F. Metal bowls are suited to conditions of rough usage and for air pressure up to 250 psi, and ambient temperatures up to 300 F. Reservoir capacities are available from ⅓ pint to 4 gallons.

Air line filters for removing dirt, pipe scale, and moisture are recommended and should be installed in the air line ahead of the air line lubricator.

Mist Lubrication

Oil mist lubricators have been designed for supplying

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light and medium oils automatically in the form of an oil fog to the bearings of small high-speed machine tools. A typical application would be the high-speed anti-friction bearings used in grinding machine spindles. Ideal lubrication of these spindles is obtained when the bearings receive just enough oil to wet the surfaces. Excess oil has a tendency to retard the speed and generate heat due to a churning action.

This lubricator is available in the form of a system which is capable of serving a limited number of bearings from a central unit. Oil is injected into a stream of low-pressure air which breaks it up into a fine mist. A filter to provide clean, dry air and a regulator to control the air are included. Oil consumption can be limited to a few drops per hour. Excessive moisture in the compressed air system can cause trouble with this type lubricator.

Oil and Grease Spraying Equipment

The first attempts at spraying lubricants were made with the aid of paint-spraying equipment. Most of the experimental and development work was done in the open gear lubrication field. As a result of these investigations, many of the lubricant dispensing equipment manufacturing companies now have a complete line of grease and oil spraying equipment to offer.

Portable hand spraying units are available which consist of a hand spray gun and tank, and are used for coating open gears, chains, lead screws, etc.

Due to the hazards involved in hand spraying and also to the ever-growing demand for continuous high-speed operation of machinery, the manufacturers of centralized lubricating systems took up the problem of spray lubrication and developed devices that will spray lubricants automatically at any desired interval, and in any desired volume. The equipment is designed to fit into a conventional centralized lubricating system, making it possible to lubricate bearings and spray gears, screws, and slides from any one system, or, if desired, the system can be set up for spray lubrication exclusively. Spray lubrication for open gears is being accepted as the most practical and economical method of application conceived to date.

Mechanical Force—Feed Lubricators

For Oil Lubrication

This type of lubricator consists of a series of plunger type pumps fitted to a tank or reservoir and driven from a common camshaft. The lubricator is usually mounted on a machine and is operated by a reciprocating link or chain connected to one of the shafts or axles of the machine. As the camshaft of the lubricator is turned, the various pump plungers are actuated by a connecting lever. On the downward or suction stroke, oil is drawn through the suction valves of the ball check type, and thence through a hollow plunger into a pumping chamber. The pressure created on the upward of pressure stroke automatically closes the suction valves and forces oil from the pumping chamber through an annular space to delivery ports, and then through delivery valves (also of the ball check type), after which the oil emerges from a nozzle into the water chamber of a sight glass and then to a discharge line leading to a bearing.

This lubricator will start and stop with the machine and also speed up or slow down with the change of speed of the machine and will handle light or heavy oils. The number of plunger pumps included in one lubricator is governed by the number of points of lubrication on the machine. The maximum number of points covered by one lubricator is usually 16. Each plunger pump can be adjusted by controlling the length of the plunger stroke, and this is regulated by an adjusting screw. The discharge can be controlled from a fraction of a drop to five drops per plunger stroke. Check valves should be installed at all bearings to prevent line drainage during idle periods.

The largest field of application for mechanical force feed oil lubricators is in engine rooms. A typical oil force-feed lubricator is shown in illustration "B" of Figure 1.

For Grease Lubrication

Mechanical force-feed grease lubricators are similar to the oil lubricator. The chief difference being in the reservoir and in the pump-driving mechanism. The reservoir is usually a cylindrical tank mounted over the pumping mechanism. A scoop, actuated by a gear on the lubricator shaft, feeds grease downward to the pumping unit. A wobble-plate, mounted on the lubricator shaft, actuates the pump plungers, which alternately draws grease into the pump and then forces the lubricant into suitable leads to the various bearings.

The mounting, drive, adjustment, number of outlets, etc., is similar to the oil lubricator. This device is suitable for equipment having a limited number of bearings in a closely confined area.

Circulating Oil Systems

Where oil lubrication is required under controlled pressure and in sufficient volume to flood the bearings continually, the circulating oil system is usually employed. The chief field of application for this type of lubricating system is in steel rolling mills, paper mills, drive gearing, motors, dynamos, turbines and engines.

There are two types of circulating oil systems in use. The gravity-feed and the pressure or forced-feed systems. In a gravity-feed system, two reservoirs are employed, one above the highest point to be lubricated, and one below the level of the lowest point to be lubricated. Oil feeds by gravity to the bearings and then drains to the lower reservoir, after which it is returned through filters to the upper reservoir by means of a pump.

The pressure system involves the use of a pump to force the oil to the bearings, which returns to tanks by gravity. Cooling is usually employed on the return lines. The pressure is controlled by the use of pressure relief valves or orifices. Forced-feed pumps are used where

large volumes of oil are to be handled. Figure 3 illustrates one of the modern circulating oil systems in popular use in industry today. Systems of this type are entrusted with the lubrication of bearing installations costing hundreds of thousands of dollars.

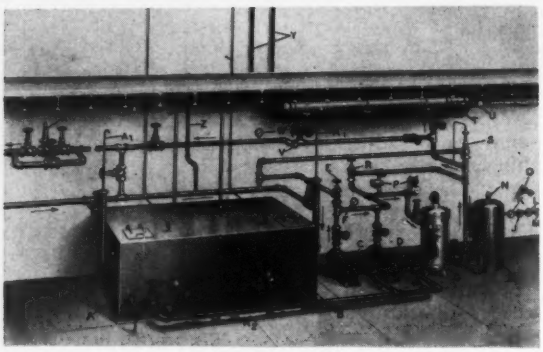


Fig. 3
Modern Circulating Oil System
(Courtesy S. F. Bowser & Co., Inc.)

** KEY **

A-Two-Compartment (or 2 single) Tank
A1-Vent
A2-Steam Coil
B-Temperature Regulating Valve
C-Circulating Service Pump
D-Circulating Spare Pump
E-Relief Valve
F-Pump Pressure Gauge
G-Figure 822 Automatic Filter
H-Pressure Tank
J-Pressure Gauge
K-Spare Pump PressureSwitch
L-Service Pump Pressure Switch
M-Alarm Pressure Switch
N-Safety Valve
O-Low Pressure Alarm
P-Filter Cleaning Alarm
R-Differential Relief Valve
S-System Control Valve
T-Cooler
U-Thermometer
V-Thermometer
W-System Pressure Gauge
X-Pressure Regulating Valve
Y-Gallonage Indicators
Z-Fill Pipe

Centralized Systems for Oil or Grease Lubrication

Centralized lubricating systems were developed to satisfy the demand of our modern, high-speed, continuous-production industries for positive and regular lubrication with accurate control over the amount of lubricant required by all bearings. Systems have been designed with these objectives in mind. The market now offers centralized lubricating systems that are manually or power operated that will provide for positive delivery of a predetermined quantity of lubricant to each bearing as often as needed, regardless of the condition or location of the bearing. Hundreds of bearings can be lubricated in a matter of a few minutes with a centralized system.

Due to the fact that centralized systems have offered such advantages as savings in lubricating time, reduction of lubricant consumption, elimination of personal hazards accompanying hand greasing, elimination of need for machine shutdown periods for lubrication, and assurance that all bearings are being lubricated, their use as standard equipment is being expanded daily. As a matter of fact, it would be impossible to successfully operate many machines of modern design without the aid of a centralized system.

The essential components of a centralized system are the central pumping and control unit, main pressure line piping, measuring valves and discharge lines. Since the most important single element in the system is the measuring valve which controls the positive delivery of lubricant to the bearing, it should therefore be sound in operating principle and simple in design. All of the successful systems now being offered use the piston displacement principle in the measuring valve.

Even though the piston displacement principle is universally employed in centralized systems, the over-all system operating principle adopted by the individual manufacturer varies considerably. Four major system principles are in use today—

(1) Single line terminating system, spring return measuring valve—indication and adjustment at measuring valve.

(2) Single line loop system, reversible flow in main supply line. Progressive measuring valve non-adjustable. Indication at end of loop.

(3) Divisional principle, divides pump delivery into number of bearing outlets. Progressive measuring valve non-adjustable. Indication at pump.

(4) Two line principle, alternating pressure applications in two main supply lines, independent valve operation. Indication and adjustment at each measuring valve.

The illustration shown in figure 4A is of a typical manually operated centralized system of lubrication; 4B is a modern heavy duty automatic system capable of lubricating several hundred bearings from one central location.

Lubricant Handling and Transfer Equipment

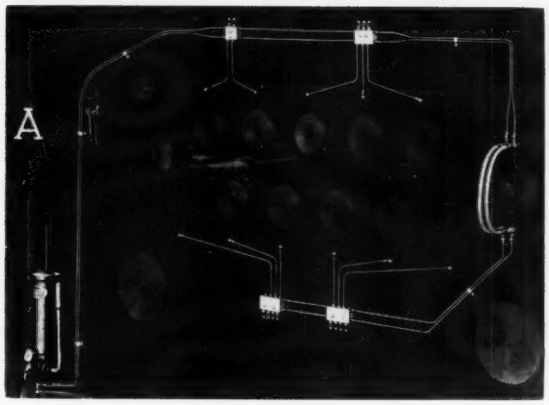
To attempt a complete description of all handling and transfer equipment on the market today, would require a rather extensive write-up and would be of doubtful value. It is important to remember that there are numerous devices available for moving lubricants from the original containers to the bearings without mess or waste, or subjecting the lubricant to contamination. Here is a brief description of a few of the major items under this heading—illustrations are given in figure 2, items Nos. 6, 7, 11, 12, 13 and 14.

Transfer Pumps

For transferring oil and grease from original drums to loader pumps, bucket pumps, or lube carts. A clean rapid method of handling lubricants. Used in grease and oil houses and are hand or air-operated, usually high volume low pressure delivery.

Loader Pumps

Are made to fit 100-lb., 35-lb., or 25-lb. containers and are used for filling hand guns on the job thus assuring clean lubricant from a closed container.



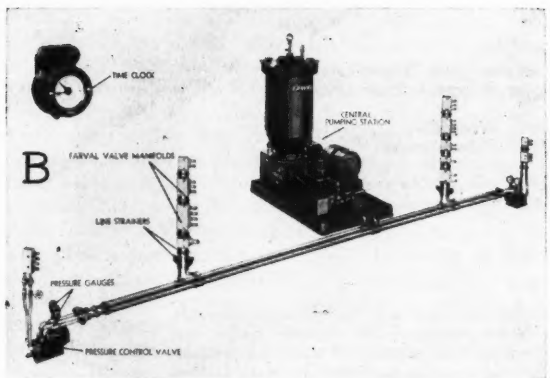


Fig. 4

A–Typical Manually Operated Centralized System
B–Modern Heavy Duty Automatic System
(Courtesy Farval Corp.)

Bucket Pumps

A volume pump which is capable of delivering 3000 psi pressure, lever or foot operated and has a 25-lb. reservoir. Used for lubricating a series of large bearings.

Fluid Dispensers

A portable crank type pump with a 25-lb. reservoir which delivers one-half pint per cycle at low pressure. Is used for filling gear housings, transmissions, rear axles, where gear lubricants or oil are used.

Portable Power Guns

Air or electric powered, mounted on wheels will handle light and medium greases and deliver from 3000 to 4000 psi pressure. For all-around use with high pressure grease fittings.

Power Barrel Pumps

Air or electric powered, designed for high or low volume delivery, also high or low pressure operation. Usually for stationary installations, and used with a long hose and hand control valve.

Complete Mobil Lubrication Units

A push cart, truck or rail car fully equipped with oil cans, grease guns, pumps for filling gear housings and oil reservoirs, gun loaders for filling hand guns. Many units are designed for electric or air power for operating some of the pumping units. This equipment has been used very successfully in servicing large industrial plants, mines and field equipment such as road machinery, tractors, construction machinery, farm implements, etc.

Conclusion

During periods of increasing costs, it is of prime importance that manufacturing operations be kept at peak efficiency. Costly shutdowns and repairs must be avoided. Labor must be conserved. Waste must be eliminated. If your plant is not already equipped with many of the modern lubrication appliances described in the foregoing, it would be advisable to make a survey of your needs. We know of no investment that will produce higher returns than one in good lubricants, and the proper equipment for dispensing them.

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NUMBER 8

SUBJECT—*Steam Turbine Lubrication*

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OIL DETERIORATION IN THEORY AND PRACTICE*

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Mr. Larsen obtained his M.S. degree from the University of Utah in 1932 and his Ph.D. from Harvard in 1935.
He then joined Massachusetts Institute of Technology as Chemist in the Department of Electrical Engineering where he remained for two years, then joined the staff of Shell Development Company in 1937. He became head of the Lubricants and Fuels Department in 1940.
Mr. Larsen has published numerous articles in the field of lubrication phenomena, oxidation, corrosion, catalysis and dielectric oils.

Mr. Diamond received his Bachelor's degree from Swarthmore College and his postgraduate training at Princeton University, majoring in physical chemistry.
In 1936 he joined Shell Oil Company at the Wood River (Illinois) Research Laboratories, and transferred to Shell Development Company, Emeryville, California, in 1942.
He has been concerned with the properties, composition and performance characteristics of lubricating oils, with special emphasis on oxidation behavior.

ABSTRACT

In industry mineral oils are called upon to perform several functions, e.g., as lubricants, coolants, and dielectrics. Hydrocarbon in contact with air is a thermodynamically unstable system and deterioration in service is generally due to the formation of small amounts of oxidation products that interfere with some phase of normal operation. Rate of aging is controlled by three factors: concentration of reactants, temperature, catalysis.
Proper design of machinery and use of antioxidant or anticatalyst additives will decrease the rate to a minimum. Alternatively, means may be employed to counteract the effects of oxidation, such as detergent additives that peptize insoluble products, basic additives that neutralize acids, corrosion inhibitors that protect metal surfaces, and mechanical filters that remove sludge.
Examples are given of practical applications of fundamental principles, namely, to internal-combustion engines, steam turbines, hydraulic equipment, torque converters, tempering, heat transfer, and electric transformers. Various uses impose widely different requirements so that no universal lubricant has yet been found. Fortunately, however, products have been developed that combine several desirable qualities and therefore fulfill many purposes.

Introduction

Oil as manufactured and sold possesses numerous characteristics that are carefully and laboriously provided because they are desirable for specific applications. The major problem then becomes one of maintaining these properties, i.e., of preventing aging on use (and introduction of detrimental contaminants). Such deterioration is the result of chemical changes occurring in the oil, generally by the action of external agents. Although straight thermal decomposition may occur simply when an oil is subjected to a sufficiently high temperature, this does not often happen in practice. Of all influences encountered, the most profound and universal one is the action of atmospheric oxygen which reacts with the hydrocarbon oil molecules by a process known as "slow oxidation" (to be distinguished from rapid oxidation or combustion).

The major difficulty is not that some of the oil is lost or destroyed (only a few percent at most ever being affected) but rather that, in addition to water and carbon dioxide, small but appreciable quantities of compounds are formed that remain in the oil and impair its functioning. For example, a highly deteriorated used oil, withdrawn from the crankcase of an automobile engine well past the normal change period, was highly corrosive and appeared to be loaded with sludge. However, on appropriate extraction and chemical treatment in the laboratory, 97% of substantially unchanged oil was recovered. The solution to the problem then is to hinder the formation of these detrimental products or to overcome their action; obviously, the first alternative is to be preferred whenever possible.

Theory of Oxidation

A full theoretical treatment of chemical reactions in-

* Paper presented at 6th Annual Meeting, ASLE, Philadelphia, April 17, 1951.

cludes, first, that branch of physical chemistry known as "Chemical Equilibrium and Thermodynamics," which tells us in what direction a reaction will proceed and how far. Since oil in contact with oxygen is an essentially unstable system because of the entropy and free energy relations involved, any attempt to nullify this innate tendency for reaction to occur would be inevitably doomed to failure. The only alternative for controlling oxidation is to slow it down to such a degree that it may be disregarded over any reasonable period of time so that the oil has a sufficiently long life in service. More important, therefore, is the subject called "Chemical Kinetics," which deals with the speed and mechanism of chemical changes.

In common with other chemical reactions, rate of oxidation is governed by three factors, namely: (1) concentration of reactants, (2) temperature, and (3) catalysis. The first is not hard to understand. Reaction can obviously occur only when molecules of the species involved collide with each other. Increasing the concentration of the reactant present in smaller quantity (say, by raising the oxygen pressure or substituting pure oxygen for air) increases the frequency of collisions between oxygen and oil molecules and therefore also the oxidation rate. Since diffusion is a slow process, only slight oxidation would occur if a still mass of oil were in contact with air; however, agitation to distribute oxygen throughout the liquid has a strongly accelerating effect. Typical examples are the churning action of gears, the swirling due to rotating shafts, the splashing caused by cranks or piston rods, and the spraying of a jet of oil impinging on a solid surface.

Since the molecules of a gas or liquid move about more rapidly as the temperature is raised, the frequency of collisions is then also increased. However, a much more important consideration is involved here. Not all collisions are effective, the molecules in many cases simply rebounding from each other unchanged. Raising the temperature raises the energy level so that the bonds between the atoms in the molecules are weakened and so a larger fraction of the total collisions occurring leads to reaction. Accordingly, the dependence of reaction velocity on temperature is very sharp and is given by the exponential equation

$$\frac{k_1}{k_2} = e^{\frac{E}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

Very often the value of E in this equation, which designates the so-called "activation energy," is such that the rate is approximately doubled for every 10 C. (18 F.) rise in temperature, but this is not an infallible rule and the temperature coefficient is sometimes much higher or lower. The oxidation rate curves of three typical oils are shown in Figure 1.

Catalysis is more difficult to explain. A catalyst may be defined as a substance which, when added to a reacting system in small quantity, greatly accelerates the reaction without being significantly altered itself. Not very long ago, little was known about this subject and, indeed, it was stated that the very use of the term "catalysis" was a confession of ignorance. A catalyst was sometimes described as being a "lubricant" for the reacting system, but such analogies proved to be of little value. In recent years, however, far-reaching advances have been made toward a sound fundamental understanding of the manifold aspects of this complicated phenomenon. Catalysis generally breaks down a process of high activation energy into two or more steps of

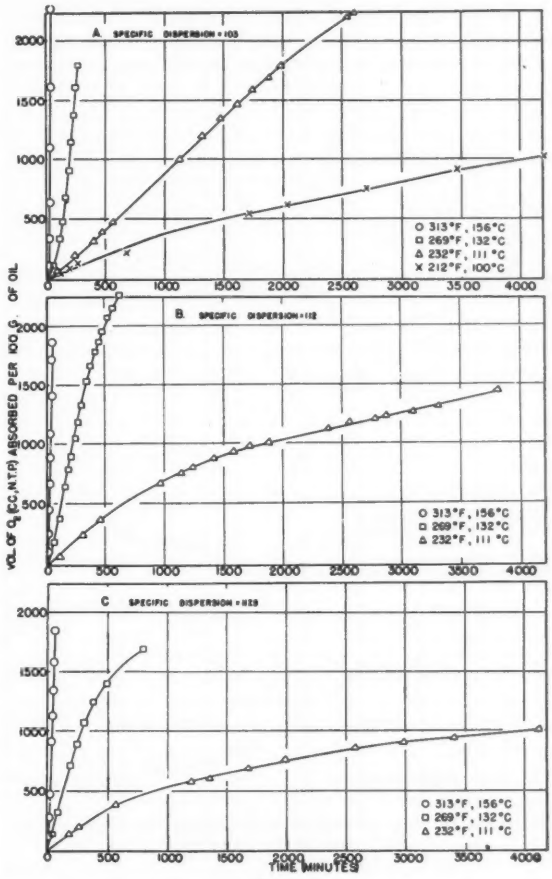
A SPECIFIC DISPERSION = 103
B SPECIFIC DISPERSION = 112
C SPECIFIC DISPERSION = 113
O 313°F, 156°C
□ 269°F, 132°C
Δ 232°F, 111°C
× 212°F, 100°C
VOL. OF O2 (CC, N.T.P.) ABSORBED PER 100 G OF OIL
TIME MINUTES

Fig. 1
Effect of Temperature on Oxidation Rate of Three Oils in the Presence of Copper

small activation energy. A good analogy is provided by the switch-back trail over a mountain, which may thus be surmounted in several easy steps instead of by a more difficult direct frontal assult. In the same way, catalysis facilitates the ascent over an energy barrier.

All catalysts fall into two general classes as follows: (1) the heterogeneous type are present in a separate phase from the actual reactants, such as a powder suspended in a liquid system or a porous solid in a chamber through which gases are streaming. These catalysts concentrate or "adsorb" one or more of the reactants at their surface. (2) The homogeneous type are actually dissolved in the reacting system, such as soluble metal soaps in oil or gasoline. Often there is a maximum in the curve for rate vs. concentration of dissolved metal (i.e., a minimum in the curve for stability vs. concentration) which indicates a complex mechanism involving the propagation of reaction chains. Very likely the metal ions in solution play a dual role, i.e., they function both as chain initiators and as chain breakers. Copper has an appreciable effect even at 1 ppm.; iron is less active at low concentrations but more active at high concentrations; lead shows a marked influence but only at very high concentrations (cf. Figure 2).

In practice, machinery is constructed of catalytically active materials which come in contact with the oil and accelerate its oxidation. Moreover, contaminants that exert a catalytic effect may be introduced into the lubricating system from outside; for example, sulfur trioxide arising from the fuel sulfur in an engine enters the

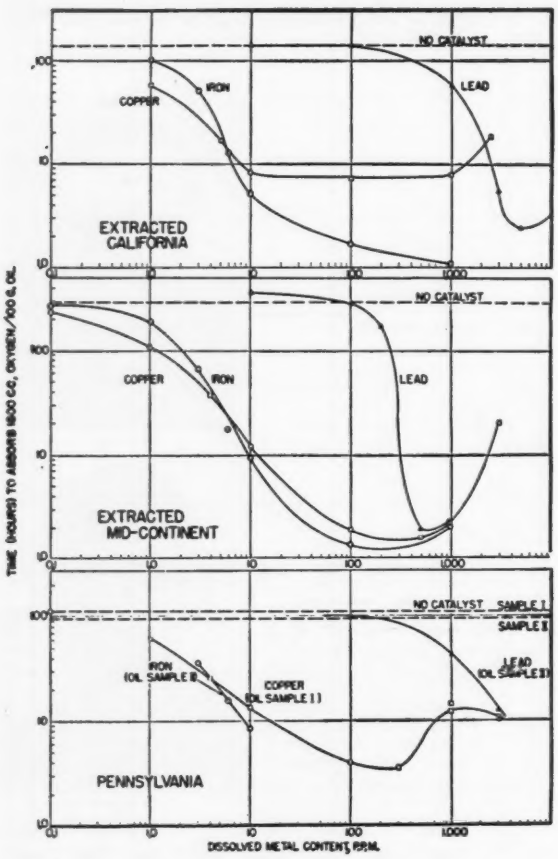

Fig. 2

Effect of Dissolved Metals on Oxidation Stability of Three Oils at 150 C. (302 F.)

crankcase as blow-by, as well as lead compounds and various metal halides derived from the tetraethyllead and scavenger in Ethyl Fluid. Alternatively, some oxidation products, e.g., volatile organic acids like formic and acetic, themselves catalyze further oxidation (and are therefore known as autocatalysts) or corrode solid metal to form salts or soaps that are more active catalytically, i.e., they act as catalyst "promoters." Similar products may be formed by partial oxidation of the fuel. Even water may behave in this way.

Effects of Oxidation

On the one hand, oxidation products are formed that are soluble in the oil but nonetheless detrimental, such as acids, saponifiable material, etc. Not only do the low-molecular-weight acids corrode and thus mechanically weaken essential moving parts and impair clearances, but also the high-molecular-weight acids, soaps, and esters act as powerful emulsifying agents when water is present. The latter are especially significant in steam turbines, as it is virtually impossible to exclude water from the system and any emulsions that may be formed are deficient in lubricating properties. Acids present in refrigerator oils may also cause copper plating on compressor parts. Most soluble oxygenated material tends to increase the viscosity, sometimes very considerably; although this effect is generally not as serious as others, it is definitely undesirable, as the oil is selected to possess the correct hydrodynamic and rheological characteristics at the outset.

More important is the formation of insoluble material which arises at later stages of oxidation and generally involves polymerization or condensation of soluble primary or intermediate products. Sludge is highly deleterious in any type of machinery unless it settles to the bottom of a sump, since it may clog oil passages and lines. In automotive engines, two types have been noted. The "coffee grounds" arising from drastic oxidation of the oil and the "mayonnaise" found in cold operation which involves condensed water and partly burnt fuel as well as the lubricant. Lacquer or varnish, if deposited in excessive quantity, may gum up sliding parts and reduce heat transfer, so that the functioning of the oil is impaired both as a lubricant and as a coolant.

Ways of Preventing Oxidation

Chemical means for preventing or hindering oxidation are provided by special compounds that, when added to an oil in small quantity, behave in a manner precisely opposite to the catalysts discussed above. Such "negative catalysts" or "antioxidants" may be subdivided into two classes known as "inhibitors" and "retardants." The former are active in breaking reaction chains, either by destroying or by dissipating the energy of intermediate chain-propagating species, so that one molecule of inhibitor is capable of forestalling the ultimate oxidation of many oil molecules. An inhibited oil, as typified by the newer turbine, hydraulic and transformer oils, shows an "induction period" during which little or no perceptible oxidation occurs, then a sharp "break" followed by reaction generally about as rapid as for the uninhibited oil (cf. Figure 3). On the other

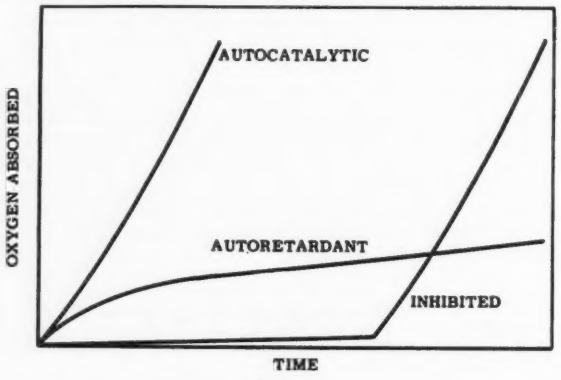

Fig. 3

Various Types of Oxidation Curves

hand, many automotive engine oils exhibit the phenomenon of "autoretardation," i.e., the oxidation rate decreases with time or remains constant. Such oils contain retardants which, though not inhibitors themselves, are converted into inhibitors as oxidation progresses.

Increase in stability may also be secured through the agency of anticatalysts or additives that counteract the influence of metal catalysts. Thus, "deactivators" react with catalytically active soluble metal soaps (either present in the oil initially as such or arising from corrosion of the solid metal) so as to precipitate them out of solution or form soluble but inactive molecular complexes. "Passivators" form a film over the metal surface, preventing direct contact of metal with oil or emission of soluble metal into the liquid. Generation of passivators in the course of oxidation also gives an autoretardant type of rate curve like that shown in Figure 4. Of course, a single chemical compound may possess more than one function. Whereas emphasis has in recent years

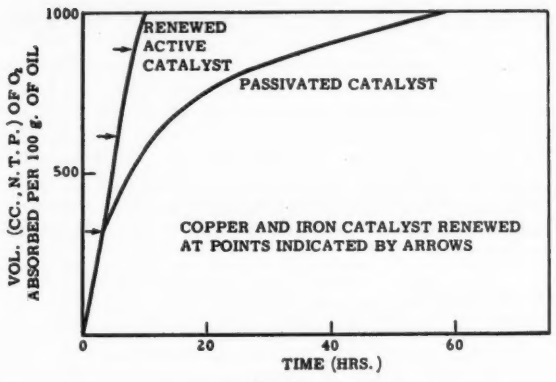

Fig. 4

Effect of Passivation on Copper- and Iron-Catalyzed Oxidation of Transformer Oil at 120 C. (248 F.)

been laid on the use of additives, the importance of selecting a suitable base oil should not be disregarded. However, this should have not only intrinsically good properties *per se* but also a high susceptibility to the beneficial action of additives.

A physical approach to the problem of controlling oxidation is involved in the adequate design of mechanical equipment. Obviously, it is desirable to avoid beating, churning, or splashing of the oil and to restrict access of air as much as possible. Inlet lines to a tank or reservoir should enter below the oil level. Deleterious volatile oxidation products should be vented off without undue aeration of the oil. Since oxidation rate increases with rising temperature, the use of oil coolers to prevent overheating is desirable; however, cooling should not be so extreme as to cause condensation of water which may act as a catalyst promoter or sludging agent. Ample oil supply to bearings will ensure that no one small portion is subjected to excessively severe conditions.

Ways of Counteracting Oxidation

Since oxidation can rarely be prevented altogether and, indeed, may sometimes be quite extensive in spite of all precautions, devices are alternatively employed to minimize the effects of any deleterious material that may be formed. Thus, so-called lubricating oil "detergents" (which are really not detergents in the usual sense but should rather be termed antiflocculants or peptizing agents) are added to an engine oil to prevent sludging or lacquer deposition in a way quite different from an antioxidant or anticatalyst. Such surface-active agents form a coating over minute particles of insoluble products so that they do not coalesce into larger particles that are capable of precipitating but rather remain harmlessly suspended in the liquid. It has recently been discovered that certain additives that were previously regarded purely as detergents really function in another manner, i.e., although they do not prevent oxidation, they alter the course of reaction so that relatively innocuous products are formed.

Corrosion inhibitors are frequently employed which form a film over metal parts of machinery to protect them from attack by corrosive acids in the oil (either formed by oxidation or introduced). Such additives are thus the inverse of passivators which protect the oil from the catalytic action of the metal, and a given compound may well act in both capacities. In analogous fashion, antirust agents added to turbine oils protect iron surfaces from water entering the lubricating system.

Still another approach is to employ agents that neutralize the acids present in the oil. Thus, the "high-ash" concentrations of certain metallic additives in diesel heavy-duty and Supplemental List oils are not only detergents but also possess sufficient reserve basicity to function in this way. The most common physical method for counteracting the effects of oxidation (and contamination) is the use of filters in lubricating systems. Insoluble particles of sludge or foreign matter are thus removed mechanically and certain filter media may even adsorb soluble polar oxidation products.

Practical Illustrations

The fundamental principles outlined above have been widely employed in the development of improved oils for internal-combustion engines and steam turbines. However, since other applications are becoming more frequent which are probably not yet so well known to the industry at large, a few examples are given below. Although the oil in many cases does not function solely as a lubricant (and, in fact, may sometimes have entirely different uses), similar considerations are pertinent.

Hydraulic Machinery

The oils or "fluids" in hydraulic presses, machine tools, etc., not only lubricate but also transmit power and actuate the control mechanism. Although the bulk temperature is moderate (in the vicinity of 66 C. (150 F.), excessively high local temperatures are often encountered owing to the effect known as "wire drawing," i.e., the frictional overheating that occurs when oil is forced at high speed through a small orifice. Obviously, the solution to this difficulty is to increase the diameter of the orifice; flow volume can then be maintained while the linear velocity is reduced and the surface : volume ratio of a given weight of the oil stream is also decreased.

Since the oil reservoir in hydraulic systems is open to the atmosphere and considerable movement of oil and variations in applied pressure are involved in the course of operation, there is apt to be some air entrainment; furthermore, iron and copper alloys are used in construction. Hence, oxidation may well occur. The deposition of asphaltic or resinous material on moving parts interferes with their action, and viscosity increase entails sluggish control, loss of power, and overheating. Whereas the earlier uninhibited products were deficient, the newer inhibited hydraulic oils have proved to be much more suitable here.

Torque Converters

In torque converters both for automotive (truck and bus) and stationary industrial installations, the frictional heat produced within the oil may cause a rise in temperature to 204 C. (400 F.) on occasion, 121 C. (250 F.) being quite common. Although the unit itself is enclosed, a large surface of oil is exposed in the reservoir which is vented to the atmosphere; "breathing" and recirculation of oil through the cooler leads to aeration. Not only oxygen but also moisture enters from the air or on filling with a new charge of oil. Ferrous and copper alloys which catalyze oxidation are employed in construction. In one instance, acids in the fluid medium corroded parts made of Tobin bronze, removing zinc from the alloy, with consequent failure; erosion may have been involved as well. Sludgy deposits or heavy lacquers are exceptionally detrimental here since clear-

ances are low and rotating parts may be gummed up. Sliding parts on shafts that are actuated by variations in oil pressure, such as over-running clutches and free-wheeling devices, would fail to operate properly.

Viscosity increase lowers efficiency and causes overheating which furthers oxidation still more. On the other hand, it is not permissible to start with an oil of too low a viscosity because this would provide insufficient lubrication, allow excessive wear, and also leak through the seals at high pressure; 30 psi. is a typical pressure at the axis of a converter and 90 psi. at the periphery in normal operation. An inhibited well-refined light oil (of transformer oil viscosity) gave excellent performance (negligible viscosity increase or deposits) after 40,000 to 60,000 miles in a mobile unit, whereas an earlier uninhibited product required replacement after 15,000 to 20,000 miles. It is especially desirable to lengthen the useful life of an oil charge here because of the high labor cost involved in changing oil. One manufacturer specifies high stability, as judged by an actual performance test, that can be met only by an inhibited oil.

Tempering

Aluminum "aging" oil is used in aircraft manufacture to give the proper temper to aluminum sheets and castings. The metal is immersed for 24 hours in the bath which is maintained at a bulk oil temperature of 121 C. (250 F.). The bath is open to the air and is agitated both by immersion and withdrawal of parts as well as by circulation to secure uniform temperature. The container is made of iron and catalytic elements are also likely to be present in commercial aluminum alloys. Oxidation is detrimental here since last portions of a highly viscous oxidized oil would drain back more slowly from a metal part, leaving more oil of a nature that is also difficult to remove by solvents; lacquer coatings are of course still more difficult to eliminate.

Since heating may be by direct flame from below, sludge deposits on the bottom of the vessel would impair over-all heat transfer with consequent local overheating and accelerated oxidation at hot spots which forms still more sludge, etc., thus giving rise to a vicious circle or "snowballing" effect. Viscosity, acidity, and carbon-residue values have been employed as criteria of stability by the industry and a useful life of at least six months is demanded. A high concentration of oxidation inhibitor in an appropriate base stock has given eminently satisfactory results.

Heat Transfer

Heat-transfer media are employed by numerous industries where uniform heating and close temperature control are desired in equipment such as kettles, tanks, autoclaves, presses, extruders, rolls, driers, etc. Water, mercury, organic chemicals, and dry salt mixtures find considerable application but mineral oils are preferred in many instances. Some systems are closed to the atmosphere and thus do not involve an oxidation problem; since temperatures up to 316 C. (600 F.) may be reached, good thermal stability or resistance to cracking is a prime requisite. However, in other machines, which are open and permit access of air, appreciable oxidation may occur, although bulk oil temperatures here generally do not exceed 204 C. (400 F.). Major parts with which the oil comes in contact are constructed of iron, but valves and fittings are often bronze or brass and copper lines are sometimes employed. Sludge deposits in heaters would of course impair heat transfer and accumulation in lines would retard oil flow. Obviously, proper design factors are essential, e.g., low heating density (energy per unit surface of heater element), sufficiently rapid circulation of oil, complete turnover of oil in tank without aeration. The necessary oil stability has been obtained both by adding synthetic chemical inhibitors in low concentration and by selecting and processing petroleum fractions that are intrinsically resistant to pyrolysis as well as rich in natural antioxidants.

Transformers

Transformer oils do not act as lubricants at all but, since they possess one function in common (viz., both are coolants), some of the requirements are the same, such as non-sludging characteristics. On the other hand, the electrical nature of a transformer imposes unique demands on the oil. Although in customary operation conditions are moderate, overloading may give rise to top oil temperatures up to 100 C. (212 F.). The oil comes in contact with the iron core, copper wire and connectors, and various types of insulating material.

Oxidation is detrimental for many reasons. Insoluble products deposited on the windings impede heat transfer from them to the oil and deposits on the inner walls of the container interfere with heat transfer from the oil to the outside, whereas viscosity increase would retard convection within the liquid. It is of course essential to have high dielectric strength (resistance to electrical breakdown), which is impaired by moisture and other suspended material formed by oxidation or introduced. Soluble oxidation products in the oil, such as acids and esters, promote emulsification of water in the oil so that it does not settle to the bottom where it would be less harmful. Polar compounds in general also increase dielectric losses. Furthermore, even traces of peroxides in the oil attack the cotton insulation on the windings, spacers, and threads used to tie various units so that it is weakened both mechanically and electrically.

Great improvements have been made by proper design. Whereas small or older types of transformers are open and permit breathing to occur so that atmospheric oxygen and water vapor are admitted, inert-gas blankets over the oil and conservator tanks are employed in the newer large units to prevent direct access of air. Clay and alumina have sometimes been used to remove water and other detrimental oxidized material by adsorption. However, the greatest advances have probably been made by increasing oil stability through the agency of added inhibitor (cf. Figure 5). Whereas one utility

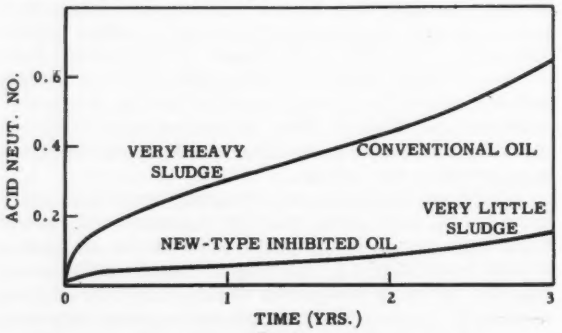

Fig. 5
Long-Term Accelerated Transformer-Oil Stability Test at 90 C. (194 F.)

(*Continued on page* 281)

ADVENTURES IN LUBRICATION*

by D. F. Wilcock

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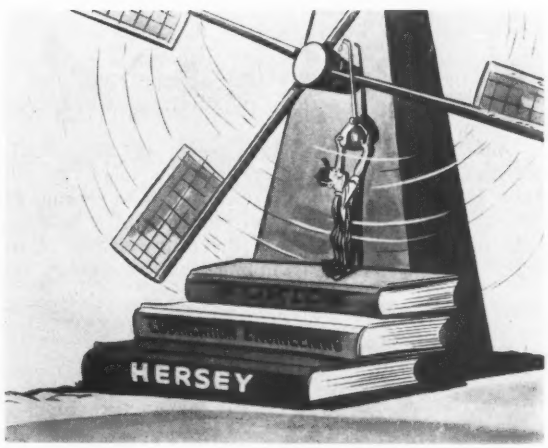
He worked on the development of silicone oils in the G. E. Research Laboratory and is at present in charge of the Bearings and Chemical Section including the Bearing and Lubricants center at the Thomson Laboratory of the General Electric Lynn River Works Plant.
He is very active in the scientific world and is a member of ASLE, ACS, ASTM and the Special Research Committee on Lubrication of ASME.

EDITOR'S NOTE

The Case of the Missing Molecule, the Case of the Brass-Plated Bearings, the Story of the Sleeve Bearing Cyclone and the Case of the Inverse Lubricant; in each of these "who done its" there was adventure, some element of danger, and a real lesson to be learned.
This article is a departure from the type of paper normally published in LUBRICATION ENGINEERING. It emphasizes, however, the element of adventure, —of new experience, awaiting every lubrication engineer, factors which too often are forgotten in everyday routine duties.

"Adventures in Lubrication" was written by an outstanding research engineer in the field of lubrication and illustrates the romance one person sees in his work even though these duties are confined primarily to the research laboratory.



Adventure is exciting, interesting, stimulating, often risky or dangerous. It is promising of new horizons, new experiences. It is the very breath of exploration, an advancement of the frontier, whether that frontier be one of geography or of science.

How many of us would be working today in the field of lubrication if it did not contain some element of adventure, some promise of new experience? How many of us, on the other hand, realize this consciously and, therefore, enjoy it to the full? We have this opportunity whether we are working in the practical field of application, or whether we are working in the research laboratory searching for new knowledge. Who can say that the adventure of trying out some new product on the grand scale of practical application, in large machines perhaps, is greater or smaller than that of discovering a new fact, a new formula, a new lubricant?

One definition of adventure given in the dictionary is: an exciting or extraordinary experience; another is: a risk, a bold or hazarous undertaking; still another: a business or commercial speculation. Thus, in one form or another, adventure is meaningful in the lives of each one of us who are specializing in the field of lubrication. In like manner, of course, it is also meaningful to those in all walks of life who take the opportunity of relishing and enjoying it. The purpose of this article is to illustrate some of the possibilities of adventure in the field of lubrication; it is not to discuss technical facts, though their presentation often cannot be dodged, but to give an insight into the rewarding experiences which may be enjoyed.

The first adventure is entitled "The Case of the Missing Molecules." Investigating the causes of bearing failures can be a source of prime adventure. As part of such an inquiry we were determining what life could be expected from high-speed ball bearings in the event their lubricant supply was cut off. It was soon found that these 50 mm bearings would continue to operate at speeds above 10,000 rpm for fifteen minutes or longer with only the oil remaining on them. They ran cooler and cooler as their time ran out, until a fraction of a second before failure. Obviously, until that final moment they were well lubricated. How little lubricant would suffice? What parts of the bearings required lubrication most?

One evening a test was being made to simulate turbine conditions, with a heavy flywheel mounted on the test shaft. The test bearing was dipped in oil and received no further lubrication. After an initial rise the bearing temperature gradually decreased, when suddenly the temperature rose rapidly; and the smooth running test machinery turned into an inferno of sound and fury. Flames and sparks poured forth as the test shaft continued to rotate at high speed, driven by the flywheel. The test room had a single door, and I dis-

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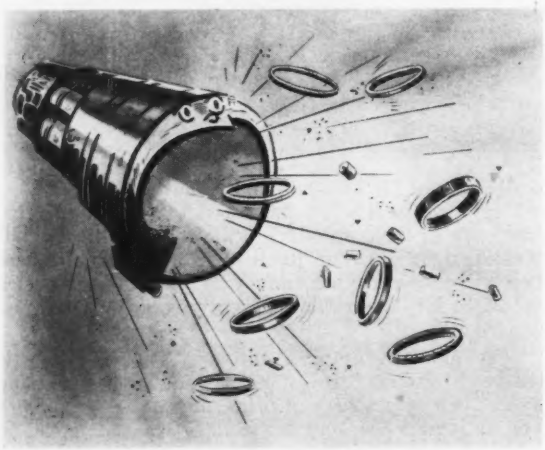
tinctly remember the frustration of being on the other side of the machine from that door. Surely the pursuit of the lubrication engineer is not without risk or adventure.

The result was a bearing as badly damaged as that from any failed turbine, proof of a possible cause of failure but providing no insight into the mechanism of failure. Further tests were made without the flywheel, and with very much less oil applied by dipping the bearings in dilute oil solutions. By stopping the bearings immediately upon the first detectable temperature rise, important facts were discovered which would be impossible to detect from the badly mauled bearings which are so often the only evidence available. The initial distress was found not between the balls and the ball retainer where rubbing velocities may be high, but between the balls and the races. Despite the tremendous pressures existing at these tiny areas of contact, a film of oil only about one molecular layer thick was sufficient to prevent the high friction of metallic contact. When heavier films are present initially, they must become depleted gradually until this critical thickness is reached. Where these missing molecules disappear to, and by what paths they depart is an adventure we are still pursuing.

Another adventure, "The Case of the Brass-Plated Bearings," had a most practical denouement, an outcome both instructive and rewarding. A certain gas turbine engine contained many ball and roller bearings, some of them large. One of the bearings, one of the larger ones in fact, was failing with infrequent but



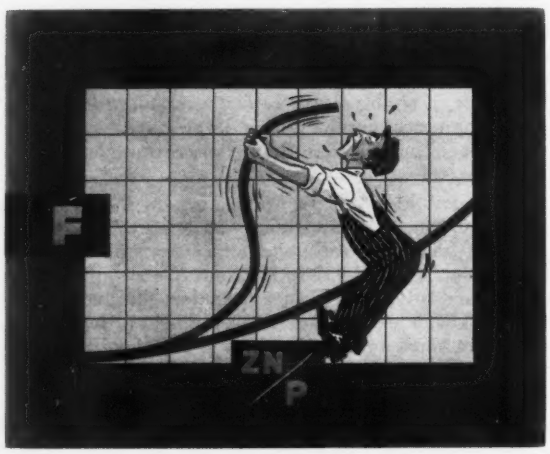
annoying regularity. Fortunately, the failures were occurring during test so that life and limb were not at stake. However, the stake in terms of the cost of replacing these bearings and retesting the engine was tremendous. Because of the nature of the engine, its complication, and its noise, it was often the case that the bearing failure was not discovered until the end of a particular test run. In the milder cases, the roller bearing separator was often fractured into two or more pieces. Although the rolls and races were coated with the bronze separator material, drastic failure had not occurred. Other failures were of the catastrophic variety and resulted in worn or misshapen rollers, fragmented and pulverized separators, distorted and badly overheated and softened races. In such cases damage to other engine parts was quite probable and the cost of such a failure was therefore tremendously increased. Surely, here was a case with tangible rewards awaiting the adventurer beyond the horizon of successful solution.

Many suggestions were offered as to the cause of the failures—poor separator material, poor separator fabrication, improper dimensioning of the bearing parts, poor mounting of the bearing, unbalance in the machine, and many others. None of these could be proven or disproven because of the nature and extent of the destruction by the time the failure could be apprehended. Fortunately, a vehicle for search was at hand in the form of a test stand in the laboratory suitable for operating bearings of this particular size under a wide variety of test conditions. The first attempt, therefore, was to use this test stand to duplicate the type of failure which was being experienced in the engine. It was soon found that failures could not be caused by reasonable variations in unbalance, by reasonable variations in bearing dimensions, or in oil flow to the bearing. Failure, however, occurred within seconds when the bearing was started and run without lubrication for a few seconds. Here was the clue.

It was found that this bearing became very hot after the engine was shut down and that the very light oil used in lubricating the bearing was completely vaporized from the bearing surfaces during this high heat period. The engine was lubricated by means of a direct connected oil pump; and, therefore, many seconds could elapse after the engine was started before lubricant reached this bearing. This period was sufficient to permit incipient failure to occur, to permit transfer of brass from the separator to the steel surfaces. Duplication of these heating and drying conditions in the laboratory, indeed, showed that this was the case. Many other separator materials were tried, and silver plate was finally selected as the most promising and the most useful. It was found that, when a silver-plated separator was used, the small amount of varnish left behind by the evaporating oil was sufficient to lubricate the rubbing surfaces until the oil was supplied to the bearing by the pump.

"The Story of the Sleeve Bearing Cyclone." This was a deliberate adventure, some years in the making. In designing our test stand for large journal bearings, it was deliberately built with enough speed and enough power to more than double the normal maximum range of speed and power in which sleeve bearings are used. Only in this way, could we be assured of finding out whether our present limits were reasonable limits or whether they could be extended with present-day bearings or with bearings of modified design.

As part of the test on each sleeve bearing, a plot of the friction factor as a function of ZN/P was kept to determine the degree of correlation between the test



points. We all know the occasional mavericks which intrude themselves into the well-ordered experiment. These are usually eliminated by duplicate experiments which perform normally in their appointed and proper manner. However, one day a bearing of large diameter and with fairly large clearance was pushed to considerably higher speeds than normal; and it was found that the friction factors for the high-speed points were much higher than would be predicted from the normal friction factor curve. Repeat experiments confirmed the discrepancy. Tests of larger clearance bearings showed the phenomenon at lower speeds.

Rest assured that this unusual behavior was mulled over on many a restless night, until the wild and remote idea occurred that this phenomenon might be due to turbulence in the very thin oil film of the bearing. Calculation of the Reynolds number for a typical high-speed run showed that it was in the vicinity of 2,000, which is in the realm of turbulent flow for flow of fluids through pipes and ducts.

Could turbulence actually occur in the few thousandths thickness of the oil film of a bearing? Soon afterwards a discussion with an authority in the field revealed that this indeed might be the case. As shown in two articles by Professor Taylor of Cambridge University, England, who more than twenty years before had considered the problem from the theoretical side and had conducted simple experiments to prove his mathematics. Cross checking soon showed that the phenomena that Professor Taylor had described in terms of relatively large spaces between concentric cylinders were operating in the thin oil film of bearings. Who can say that the adventurous search for a gold mine is more persistent, more untiring, more rewarding, or more deliberate than the systematic search of the development engineer and scientist for the phenomena outside the normal range of his experience?

The last example concerns Protective Coloration, or "The Case of the Inverse Lubricant." It has been my privilege to have been associated with the development of silicone oils and their evaluation as lubricants. Here was a whole class of materials which appeared to possess almost all the desirable attributes of the perfect lubricant: great chemical stability, ability to withstand high temperatures, extremely low pour points, and unusually low change in viscosity with temperature. Yet in many trials of silicone oil as a lubricant for machinery, particularly machinery for unusually severe and arduous jobs, lubrication failures, wear and seizure have occurred.

In reviewing the development of these oils as lubricants, one is reminded of the protective coloration which is provided by nature for many species of wild life and vegetation. Normally they are well-adapted to and blend with their surroundings and thereby survive and multiply. If they are removed from the surroundings for which they are adapted by nature, they stand out against the strange background: They no longer have protective coloration, and their survival percentage is thereby greatly reduced.

In our adventures in lubrication, we are so accustomed to see petroleum oil working successfully with bearing materials to which it is adapted that we forget that this adaptation is similar to the protective coloration of nature. We forget that there are many combinations of materials with which petroleum oil is not adapted for use as a lubricant. As designers, we have learned to avoid such materials because our collective experience has taught us that compatibility or protective coloration is absent.

When silicone oils are evaluated against the background of bearing materials for which petroleum oils are adapted, we are startled to find that the silicone oils do not have the protective coloration or adaptation for many of these materials. However, when we set out to explore the range of possible materials with which these silicone oils might be used, we find that there are many combinations with which they work very successfully. And so we must conclude that when working with an entirely new specie of lubricant, we must explore beyond our normal range of experience in order to discover the combinations of materials which form the proper background for the protective coloration of the new specie.

Thus, one might fairly ask—was the new lubricant missing or misused? A look at the other face of the coin is often rewarding. This brief view down one vista of a new field of development glosses over several important explorations in which the spirit of adventure has had full play. These explorations have covered the full range from the very practical search for compatible bearing material pairs and for additives which will widen the range of compatible materials so that they overlap the range useable with petroleum and petroleum-like products, to the exploration of more theoretical aspects such as the attractions between the molecules of a liquid and that of an adjacent metal surface and the very nature of boundary lubrication.

Some explorers suspect from the horizon they see that silicones fail in conventional applications because of the very chemical stability which we have prized so much but which may reduce the possibility of interaction with the bearing surface. To such people, the products of decomposition or impurities in petroleum lubricants largely account for their effectiveness. Other explorers find on their horizon indications that difficulty may be caused by the local high temperatures which arise when two metal surfaces rub together even when they supposedly are separated by a lubricant. These high temperatures, caused by the rubbing of asperities of corresponding surfaces upon each other, may result in the case of petroleum products in oily and tarry residues which continue to act as a lubricant, while in the case of silicone oil high temperatures may result in decomposition of the molecule and the formation of a more abrasive silica-like material. Frankly, this is a controversial subject, but a new technology is being developed with which lubrication with silicone oils appears to be just as feasible as lubrication with petroleum oil, provided proper choice of material is made, for those applications where the use of the more costly synthetic oil is justified. The adventure in silicone oil is, as you can see, far from completed.

As is always the case in every field of endeavor, the attainment of one horizon discloses another lying still farther beyond. How satisfying it is to know that we have not attained the ultimate and that progress and development lie open before us and the generations of adventurers who will follow. Let us review some of the paths of further adventure which are open today, always remembering that the picture tomorrow, next year, or in the next century may be entirely different. Ball and roller bearings, provided they are properly lubricated during their life, have a mortality curve strikingly similar to that of human beings. What accounts for the early mortality of a few? In the case of human beings we know it is the result of disease or accident. In the case of bearings, is it the disease of nonuniformity in the steel in a particular portion of a particular bearing? Or, is it the disease of a flaw in the preparation of the

working surface of the bearing? Or, is it both? Here, indeed, is a fertile field for the adventurer who can find a capitalist to grubstake him. You will say that this is not a lubrication problem. But, is it ever possible completely to separate the effects of the lubricant from the effects of the bearing material and of the bearing design? This is the triumvirate with which we must deal.

The problem of special lubricants is always before us. Here we have the opportunity to be the servants of progress in other fields of engineering whose advancement often awaits our development of lubricants which can operate at higher temperatures or loads, or lubricants which will permit operation at extremely low temperatures. It is not necessary to emphasize the importance of such developments, not only to general progress, but also to the very defense and life of our country. What an opportunity! What a prospect! What a risk! Many of us are involved in this search and have found how unwise it is to attempt to apply conventional materials beyond their normal range of usefulness. Thus, for example, a grease for use at high temperatures must embody both an oil and a thickener which are stable and long lived. Failure to follow this principle results in products of only transitory usefulness.

Thrust bearings often must occupy relatively large areas of large diameters in order properly to support tremendous loads in rotating machinery. These factors result in large power consumption which reduces efficiency. What an opportunity for the inventive entrepreneur to develop radically new and more efficient designs.

All of you can add many many items to this list, items drawn from your own experience. Surely, our prospect is adventure with horizon unlimited. Let me emphasize again that if you will but lift up your eyes, no matter what your station, no matter what your responsibilities or position, adventure is in your daily life. It is not something open only to the select few in the jungle, on the high seas or in the research laboratory. It is something upon which our daily lives are based, albeit unconsciously. It is my hope that this discussion will encourage you to see the adventure in your own experiences and to enlarge upon them.

SEE LUBE LINES — FEBRUARY
SECOND SUMMER COURSE
LUBRICATION ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA. (ASLE)

PLANT MAINTENANCE SHOW

January 14-17, 1952
Convention Hall
Philadelphia, Pa.

Conference sessions and exhibits will place principal stress on preventive maintenance.

Highlight of the conference will be the division into more than 30 separate sessions in order to accommodate special talks on individual industry needs and to permit executives to discuss problems that arise in plants of varying sizes and varying maintenance needs.

Industries to be covered separately include chemical plants, metal producing, metal working, aircraft, food, glass, oil, printing, pulp and paper, textile, and woodworking.

Particular problems to be discussed include maintenance of plant buildings; electrical, mechanical, powerplant and service, and materials handling equipment.

General sessions will be on maintenance costs, project preparation, inspection methods, scheduling of maintenance work, training workers and supervisors, personnel, operating policies, safety and plant protection, housekeeping and welding.

Of particular interest to our readers will be the Lubrication Panel Discussion on Wednesday morning, January 16, conducted by ASLE. Our Panel Discussion this year will be functional in its approach to the various problems presented for solution.

Such subjects as Lubrication Under Extreme Variation of Temperature; Pressures; Care and Maintenance of Hydraulic Fluids; Bearing Loads and Pressures; Care of Cutting Fluids—all of which the members of our Panel are adequately equipped to discuss from experience background.

Panel Chairman:

Prof. Wilson P. Green, Heat-Power Research Department, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Panel Members:

Dr. M. E. Merchant, Assistant Director of Research, Cincinnati Milling Machine Co., Cincinnati, O.

D. M. Cleaveland, Lubrication Engineer, Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.

C. A. Bailey, Lubrication Engineer, National Tube Co., Pittsburgh, Pa.

M. A. Hayden, General Sales Manager, Waterbury Tool Div. of Vickers, Inc., Waterbury, Conn.

The exhibits will place stress on preventive maintenance. ASLE will occupy a booth with personnel in attendance for information on the Society, Panel Discussion and Lubrication Problems.

Conference information may be had by writing L. C. Morrow, Consulting Editor, *Factory Management and Maintenance*, who is serving as General Chairman of the Conference.

Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, New York.

EXPERIMENT AND EXPERIENCE

Useful ideas, advances in lubrication practice, or helpful hints to other "Lubricaneers" can most usefully be contained in short notes. One of two things usually happens to important observations of that kind; i.e., they are unsuitable for development into a full length paper, or if expanded become submerged and their value lost when included as a minor observation. Therefore, their usual fate is "to be lost for want of a place to be broadcast."

The title reflects the proposed scope of this feature. Subject matter will cover well-established, practical observations as well as what might be termed "research notes." We are presenting this opportunity to all "Lubricaneers" to publicize their own findings or ideas on lubrication.

It is the prime objective of these articles that they be as concise, complete and readable as possible. In order to create both maximum reader interest and to set the style for future contributions, it is desirable, generally speaking, to state both the objectives and conclusions early in the article and then to fill in such details as may be required to give the full understanding of the scope and limitations of the reported findings.

The feature will not necessarily appear in consecutive issues of LUBRICATION ENGINEERING. *Deadlines for contributions to* Experiment and Experience *are the first of the month prior to the month of publication.*

Roller Bearing Temperature Controlled by Method of Applying Lubricant

By E. F. Macks and Z. N. Nemeth
N.A.C.A., Cleveland, Ohio

Recent experiments have shown that the temperature rise of high-speed roller-bearings can be markedly reduced, for a given lubricant flow, by increasing the number of jets through which the lubricant is supplied to the bearing. In brief, it was found that oil supplied by two jets, spaced 180 deg. apart, produced lower inner-race and outer-race bearing temperatures than did the same quantity of oil supplied by a single jet. Still lower bearing temperatures were obtained when several jets were used and in addition, temperature variations around the circumference of the outer-race were reduced.

The present studies were made with a 75 mm. bore (size 215) cylindrical roller-bearing with an inner-race-riding cage. A constant radial load of 368 pounds was used over a range of DN values (product of the bore in mm. and the shaft speed in rpm.) from 0.3×10^6 to 1.2×10^6. Further details of the experimental apparatus and general procedures are given in reference 1.

As an example of the magnitude of the differences in bearing operating temperatures it is cited that at an oil flow of 3 pounds per minute and a DN value of 1.2×10^6, the outer-race-maximum temperature is 19 F. less and the inner-race temperature is 34 F. less when the bearing is lubricated by single-opposed-jets rather than by a single jet. It is also cited that at an oil flow of 6 pounds per minute the outer-race-maximum temperature is 60 F. and the inner-race temperature 92 F. less when lubricated by multiple jets rather than by a single jet. As a further example of the effectiveness of the multiple jet method of lubrication, the outer-race circumferential temperature variation was found to be 5 F. for the multiple jet method in contrast to 35 F. for the single jet method and 93 F for lubrication by means of the outer-race hole.

Reference 1. Macks, E. F., and Nemeth, Z. N.: Investigation of 75-millimeter-Bore Cylindrical Roller Bearings at High Speeds. III—Lubrication and Cooling Studies. Oil Inlet Distribution, Oil Inlet Temperature, and Generalized Single-oil-jet Cooling-Correlation Analysis. NACA TN 2420, July, 1951.

Oil Deterioration

(*Continued from page* 276)

company found it necessary to renew the oil in unprotected transformers every 5.6 years on the average, the useful life of the newer products should be increased 3- to 5-fold, on the basis of field performance tests. Transformer oils are of necessity well-refined but, by judicious processing, sufficient natural antioxidants may be left behind so that not only is a long induction period obtained but also the rate of oxidation is not excessive after depletion of the additive. It may even be possible to raise the service life of the oil to that of the transformer itself and the trouble of changing oil will then be completely eliminated.

General Considerations

Since various applications subject an oil to different conditions and impose different requirements, a tailor-made lubricant for each would be desirable. Thus, let us compare a diesel oil with a turbine oil. Which application is more severe? The diesel involves higher temperatures than does the turbine as well as fuel soot and oxidized material. On the other hand, a turbine may introduce large quantities of water into the lubricant. The turbine oil is sometimes inadequate for the diesel engine because it is not sufficiently stable and does not possess sufficient detergency. The diesel oil is inadequate for the turbine because the detergent present therein would act as an emulsifying agent. Hence it is impossible to say categorically that one application is more or less severe than the other. Each one has its own unique requirements which must be considered independently.

On the other hand, it would be convenient, in maintaining an industrial establishment, to avoid the necessity for stocking a different oil for each piece of machinery. Although a universal lubricant has not yet been found, products have been developed that serve several purposes so that the total number needed is not unduly large.

PROPOSED LIST OF MATHEMATICAL SYMBOLS FOR LUBRICATION PROBLEMS

To cooperate with our Educational Committee in giving the widest possible distribution to their tentative mathematical symbols and serving the interests of expediency in securing a collected opinion, we feel publication of the Committee's article in its entirety is desirable.
The symbol list is subject to change and when the approved version is available it will be published in LUBRICATION ENGINEERING—Ed. Note.

by John Boyd
ASLE Educational Committee

One of the important functions of A.S.L.E. is to promote a better understanding of lubrication through the publication of papers and monographs. In keeping with this objective, the Educational Committee* has undertaken the preparation of a series of monographs on lubrication subjects. Two of these have already been published and others are under way.

During the early stages of this work, the Committee decided that, in view of the lack of uniformity in the use of mathematical symbols and in the meaning of terms found in the literature, a study should be made of the problem and standard symbols and definitions established.

After consulting numerous texts and articles on lubrication and after checking the standards already in force in other fields, the committee finally adopted the tentative list of symbols given below. These symbols will be used in the forthcoming monographs and it is hoped that authors of papers to be published in LUBRICATION ENGINEERING will also employ them in their manuscripts. A glossary of lubrication terms, now being prepared, will be published at a later date.

General Principles

In setting up the symbols for lubrication, the following general principles based upon the experience of other standardizing groups, were followed:

1. It is not necessary to have a separate symbol for all the quantities which are encountered in lubrication calculations, but only for those quantities which are in common use and which would involve confusion if different authors used different symbols. It is better to keep the number of symbols as small as possible. Additional symbols can be added from time to time if the need arises.

2. Authors cannot and should not be forced to use a given set of symbols. Their use is entirely voluntary. Thus it is desirable to permit the use of alternate symbols wherever possible provided they do not result in confusion with the symbols for other quantities.

3. The establishment of a given symbol to represent a given quantity does not mean that an author cannot use the same symbol to represent another quantity for which no symbol has been assigned. It merely means that, when dealing with quantities for which standard symbols exist, he should use the established symbol.

4. The establishment of a symbol for a quantity does not determine the units in which the quantity is to be expressed. Any consistent system of units is satisfactory.

5. Since other branches of engineering have already gone to considerable trouble to set up their own standard symbols and since the American Standards Association has done an important job of correlating the symbols for the various branches, every effort should be made to conform to the pattern already set.

Comments on Individual Symbols

As previously mentioned, the accompanying symbols have been chosen after a careful study of various texts and papers on lubrication. In most cases there are fairly compelling reasons for the choice of symbols shown. Some cases, however, deserve additional comments.

The symbols B, b, for breadth parallel to the direction of motion and L, l, for length perpendicular to the direction of motion have to be considered together. Although, at first glance, it might seem more logical to L, l, for length parallel to the direction of motion, most authors use B, b, for this quantity. There is good reason for this since in teaching one starts with the simple slider bearing having the dimensions B and L and then proceeds to the journal bearing having the dimensions D (diameter) and L (length perpendicular to motion). Since the meaning of D and of L is evident and so well established in the case of the journal bearing, consistency makes it necessary to use L, l, for the dimension perpendicular to motion on other bearings (such as the slider bearing) also.

The letters C, c. for *radial* clearance may call for further discussion. Some people like to work with diametral clearances since in full bearings it is rather easily measured. However, in practically all mathematical treatments, it is much easier to deal with radial clearance, in fact in the case of partial bearings, diametral clearance does not have much meaning. The use of C/2 for radial clearance, where C is the diametral clearance, has the objection that it is too complicated for a term which must be worked with so frequently. It has also been suggested that small c be used for radial clearance and large C for diametral clearance. This is satisfactory in printed matter, but, in the classroom, it results in confusion since a large C and a small one look alike in spite of the instructor's best efforts to show a difference and sound alike regardless of anything he can do. Since the teaching angle is very important in broadening the understanding of lubrication, it was felt

*The Education Committee, under whose auspices the accompanying list of symbols has been prepared, comprises the following: D. D. Fuller (chairman), N. M. Aycock, A. R. Black, J. Boyd, J. T. Burwell, W. E. Campbell, J. I. Clower, G. R. Dunne, W. T. Everitt, D. F. Hollingsworth, S. Kyropoulos, C. M. Larson, R. H. G. Mathews, C. E. Pritchard, E. S. Ross, R. G. Sharpe and A. J. Zino. In preparing the list, the committee was fortunate to have the comments and suggestions of Mr. M. D. Hersey.

that the radial clearance should be the primary unit, permitting either large C or small c to be used as a symbol.

It will be noted that no symbol is included for heat, or the amount of thermal energy. Inasmuch as one is almost always much more interested in the heat rate (amount of heat per unit time), this omission is not objectionable. A further reason for leaving out a symbol for heat is that the only logical symbol for it would appear to be either h, or H which would result in conflicts with film thickness and power. The symbol here chosen for heat rate is q which is the A.S.A. standard for heat and thermo calculations.

Because of the wide use and acceptance of μ N/P in bearing literature, it is almost mandatory that large P be reserved for the load per unit of projected area. To distinguish the load per unit of projected area from the total load it was decided that the latter should be designated by large W.

Probably the hardest term to fit into the already accepted A.S.A. standards is that for power. These standards in all the cases examined use the letter P. As already pointed out, special usage in lubrication has strongly identified P with the load per unit of projected area. It seems wise not to attempt to change this. The use of H for power, as here employed, agrees with the usage in many books and lubrication articles but of course is at variance with the A.S.A. To provide a symbol more in keeping with the A.S.A. the letter, P, with a subscript, r, or P_r, has been added as an alternate. It should perhaps be noted here that the symbols HP and HP sometimes used for power should, in the interest of standardization, be avoided; the first because it requires a character not usually stocked by printers and the second because it implies a product of H and P.

The alternate symbol, Θ, for temperature is intended for use when time and temperature occur in the same equations. This is similar to A.S.A. usage in the Mechanics of Solid Bodies.

Although there seems to be general agreement in other fields on the use of μ for absolute viscosity, some people in lubrication prefer to use Z. For this reason, the latter term has been added as an alternate.

General Acceptance by A.S.L.E.

As previously mentioned, the accompanying list of symbols was prepared by the Educational Committee for use by them in their monographs on lubrication. However, it is hoped that the list, or some revision thereof, will be accepted by the Society at large and that it will eventually become an A.S.A. standard for lubrication. Comments or suggestions in connection with the matter are solicited but should be sent to the writer by Feb. 1, 1952, so that they may be considered at the next Committee meeting. Address John Boyd, ASLE Educational Committee, Westinghouse Electric Corp., Research Lab., Ardmore Blvd., East Pittsburgh, Pa.

Proposed List of Mathematical Symbols for Lubrication Problems

α	acceleration, angular
g	acceleration, gravitational
a	acceleration, linear
$\alpha, \beta, \gamma \ldots$	angles
ω	angular velocity
A	area
B, b	breadth, width (par. to dir. of motion)
C, c	clearance, radial
f	coefficient of friction
α	coefficient of linear expansion
ρ	density, mass per unit vol.
D, d	diameter
e	eccentricity, brg.-jnl. center dist.
ϵ	eccentricity ratio, eccen./rad. clear
η	efficiency
δ	elongation, deformation, displacement
E	energy, work
h	film thickness, thickness
W	force, load
F	friction force
q	heat rate, heat flow rate, heat per unit time
λ	heat transfer coefficient, heat flow rate per unit area, per degree
L, l	length (perp. to dir. of motion)
W	load
P	load per unit proj. area
G	lubrication number, μN/P, ZN/P
m	mass
J	mechanical equivalent of heat
M	moment of force
n	number
H, P_r	power
p	pressure, force per unit area
R, r	radius
N, n	revolutions per unit time
τ, s	shear stress
R	shear rate
S	Sommerfeld number, $(R/C)^2$ (μN/P)
c	specific heat
T	temperature, absolute
t, θ	temperature, ordinary
Δt	temperature difference, temp. rise
k	thermal conductivity, heat flow rate, per unit area per unit length, per degree
t	time
M	torque
u, v, U, V	velocity
μ, Z	viscosity, absolute
ν	viscosity, kinematic
V, V_L	volume
Q	volume rate, flow rate, vol. per unit time
γ	weight per unit vol.
E	work

FIFTH ANNUAL ALL LUBRICATION SHOW

APRIL 7-8-9, 1952 HOTEL STATLER—CLEVELAND

Representative industries participating:

LUBRICANTS **CUTTING FLUIDS**
LUBRICATION DEVICES **HYDRAULIC FLUIDS**
FILTRATION **RUST PREVENTIVES**

LUBRICATION SUMMARIZED

In the interest of obtaining optimum reader attention to salient points presented on the various phases of lubrication before the Sections of ASLE, we are inaugurating this new feature Lubrication Summarized.

Practical aids, actual results, vital informative data will be offered in as concise a manner as possible.

Read this feature! You may find the answer to the very problem that has been confronting you.

Some Industrial Experiences With Synthetic Lubricants — By C. H. Sweatt and T. W. Langer.

Submitted by M. C. Miller, Secretary, Pittsburgh Section ASLE

Recent developments in synthetic lubricants have provided the solution to a variety of industrial lubrication problems involving unusual or severe operating conditions. The polyalkylene glycols and their derivatives, known in industry as "Ucon"* lubricants constitute one class of synthetics differing considerably from petroleum products in physical and chemical properties. Five years of practical experience with these fluids have revealed various applications where their use has resulted in improved operation of mechanical equipment or substantial savings in production costs. A number of such experiences are described in some detail to illustrate the types of service in which the polyalkylene glycols may prove advantageous. Considerable emphasis is placed on actual performance records of the synthetic fluids in direct comparison with results obtained in the same equipment with conventional lubricants.

*Registered trade-mark of Union Carbide and Carbon Corporation.

Bentone Lubricants, Their Development and Properties — By D. H. Compondu, The Warren Refining and Chemical Company.

Submitted by W. H. Miller, Chairman Section News Committee, Buffalo Section ASLE

It was pointed out that Bentone lubricants are not true greases in that they do not depend on an interwoven soap matrix to gel oil. A Bentone lubricant's gel system is formed by physical attraction between the oil phase and the Bentone platelets.

The fact was stressed that the Bentone used to gel oils was not to be confused with bentonite clay also called montmorillonite, since it is actually a purified reaction product of the latter. By super-centrifuge and base exchange processes, montmorillonite is converted to the hydrophobic, organophilic Bentone which is in the form of platelets about twenty millimicrons square by two millimicrons thick.

A summary of Bentone lubricants' properties according to Mr. Compondu are:

1. Working stability—excellent
2. Consistency-temperature characteristics—excellent
3. Melting point—none
4. Copper corrosion—negligible
5. Bomb oxidation—equivalent to conventional greases
6. Metal adhesion—excellent
7. Wear—equivalent to conventional greases
8. Water resistance
   a. Washing action—excellent
   b. Absorption—up to 125% by weight
   c. Rust prevention—good when inhibited

Discussion developed the fact that Bentone lubricants will lubricate efficiently up to the flash point of the base oil they contain, and are in instances used at temperatures exceeding this. It was also stressed that proper re-lubrication is still necessary when using Bentone lubricants. Frequency, amounts and types depend upon the particular operation and operating conditions.

Application of Lubricant—By R. C. Lohbauer, Production Engineering Staff, Spicer Mfg., Division of Dana Corp., Toledo, Ohio.

Submitted by E. S. Kelly, Detroit Section ASLE

In the interests of better plant lubrication, and as an aid to increased production the following corrective steps were taken:

1. Reduction of lubricating fittings to one type only, whenever possible. The type chosen was the high pressure, hydraulic type with a ball in the head.
2. Standardization of lubricants, guns, adapters, etc.
3. Requested that machinery manufacturers adhere strictly to lubrication fittings according to specifications furnished in the original design.
4. After testing centralized lubricating systems and adopting one type, proceeded to install it on the most vital machines in use. Operating cost records were compiled *before* and *after* installation.

On a multiple operations index type machine for turning, boring, drilling and reaming, there had been an allowance of 15 minutes each day for the operator to lubricate 21 points on this machine. After the installation of automatic systems on a battery of 60 machines of this type the following results were achieved:

1. Reduction of maintenance costs, 60% or $72,000 annually, including labor and material.
2. Increase of 20% in production from these machines. (Equals a saving of 12 additional machines at a capital expenditure of $816,000).
3. A consistent improvement of quality of work effecting a substantial reduction in scrap.
4. Reduction of operators' allowance for lubricating time amounting to a direct labor saving of 5% per one hundred pieces, or, $25,000 annually.

Mr. Lohbauer reported high savings on other plant equipment by the installation of proper lubricating appliances and lubricants, and re-designing of all lubrication schedules.

Lubrication of Power Plant Equipment—By F. C. Linn, General Electric Company.

Submitted by W. H. Miller, Chairman Section News Committee, Buffalo Section ASLE

Three important factors which must be controlled in a turbine lubricating system are—(1) Rusting, (2) Sludging, (3) Foaming.

Rusting results from moisture which can enter the system through

leakage as well as shut-down condensation and atmospheric humidity. Rust inhibited oils are greatly aiding prevention of corrosion below oil levels and Mr. Linn recommended use of special paints in storage tanks to prevent rusting above oil levels.

Oil oxidation is the main cause of sludging and can be reduced by using oxidation inhibited oil and eliminating contaminants which act as oxidation catalysts.

Loss of oil from overflow and binding of return lines are the most serious problems resulting from foaming. Foam is generated in bearings due to the inherent vacuum created in non-load areas. Use of anti-foam agents, elimination of sharp bends and restrictions in return lines and running return lines half full are recommended.

General Electric at Schenectady have developed a new test set-up to determine foaming characteristics of oils under conditions similar to those found in actual bearings.

The use of oil conditioning equipment — at least periodically if not continuously — was strongly advocated.

Mr. Linn concluded by outlining the future trends and needs of turbine lubrication as:

1. Improved oxidation inhibitors.
2. Improved rust inhibitors capable of protecting surfaces for long periods of time, especially after shut-down or draining, in which cases many surfaces are no longer bathed by the oil-contained inhibitor and are dependent on the ability of the inhibitor already there to remain and continue to provide protection.
3. A slushing compound which would give absolute protection to turbines during pre-use storage and shipment but would be compatible with turbine lubricating oils, thus eliminating costly cleaning and possible contamination of the lubricating oil.

Cutting Fluids and Their Contribution to the Defense Effort—By W. H. Oldacre, President, D. A. Stuart Oil Company, Chicago, Ill.

Submitted by E. A. Mohr, Secretary, Los Angeles Section ASLE

Development has been rapid in the science of building and using machinery to shape metals by employing edged tools. Certain basic problems appear deceptively simple in view of the complexity of the plastic and elastic behavior of metals under the great range of temperatures to which they are subjected. Metallic seizure, scuffing, lubrication and heat transfer are all factors that must be considered.

The two types of cutting fluids are water soluble and oil base.

Mr. Oldacre stressed the tremendous bearing that chip structure has on the results to be obtained in metal working. Just what action takes place in the microscopically small area where the actual metal deformation occurs is still somewhat mysterious. However, the action can be predicted, speeded up, retarded and to a great extent controlled by the application of different mechanical methods and the use of different cutting fluids.

Temperature control is of primary importance, not only in the workpiece itself where the water soluble products dissipate heat efficiently but particularly in the immediate cutting area. Here it is that an oil base cutting fluid is most effective.

The rather ambiguous term "Lubricity" is used in describing the action taking place in minimizing the seizing tendency of rubbing surfaces under great pressure. This is a characteristic inherent to oils but they often require an aid or booster to prevent welding or scuffing. Sulphur has for years been recognized as the most efficient anti-weld agent. Prior to its use in cutting oils machining was done under handicaps with mineral oil and animal fat additives.

To Mr. Oldacre an old but very important axiom is to remember that in machining metal "the chips are being made and the workpiece is what is left."

Keep 'Em Running—By C. H. Parks, Bullard Machine Co., Bridgeport, Conn.

Submitted by A. S. McNeilly, Secretary, Boston Section ASLE

Mr. Parks' plan of attack to organize maintenance and lubrication at his plant was as follows:

1. A Lube Department set up jointly with the Repair Department.
2. This form of maintenance department was given plant authority; i. e., to stop machines before failure and to have suggestions and recommendations adopted.
3. Place source limitations on purchasing of lubrication products.
4. Number of products used cut to a minimum with careful consideration of quality.
5. Coding of oils.
6. Setting up card indexes for all machines in order to keep a complete lube and repair record.
7. Setting up oil and grease specifications for operating plant equipment and newly manufactured machines being shipped out.

Mr. Parks' closing axiom: "Good lubrication with good care will keep 'em running."

Paper Mill Lubrication—By W. S. Miller, Gulf Oil Corporation.

Submitted by D. W. Moore, News Reporter, Cincinnati Section ASLE

The three main enemies of lubrication in the paper industry are air, water, and heat, plus the added problem of oil seepage through seals to the felt rolls, thus contaminating the product.

The modern paper mills have anti-friction bearings on the rolls and a circulating lubrication system has proven the superior method of application. In some new installations this circulating system may only be in use on the dry rolls and back gears. Because of the heat and sludge formation, this system has given very good results. Bearing manufacturers are cooperating to the fullest extent in designing roll bearings (usually the dry sump type), to give complete washing through the bearing plus efficient cooling. Since temperatures border on 350 F. the practical limits of petroleum base lubricants are approached; therefore, additives are used. These additives are for moisture, sludge, and film strength, the latter being the least important as extreme pressure is not of too much concern.

Proper design of the circulating system should not be forgotten. Such things as bearing size, machine size, pump size, and filter size can mean a great deal. The location of the filter and clean oil storage tank is another item of consideration. Ideally, these last two pieces of equipment should be in a room separate from other equipment and kept clean and dry. The modern tendency is to change the location of such equipment from under the paper machine to a location of cleaner and drier nature.

The purification system should be composed of the following items:

1. Settling or Precipitation Tank. This decreases the load on the filter and should be designed to allow 1 to 1½ hours settling time. Oil coolers are sometimes required as the settling temperature should be maintained between 130-150 F. The lower

temperature insures rapid settling while the upper temperature prevents oxidation.

2. A Reliable Filter of the Proper Capacity.
   Magnetic filters may be used in conjunction with the regular filter.
3. Clean Oil Tank.
   Generally speaking, a large system is better than a small one because oil changing is less frequently required.

It might be stated here that the circulating system is not practical for use on the internal machine for mechanical reasons and moisture problems. Grease would be the best answer. Surprisingly enough sodium base greases are used here with great success with the exception in spots where extreme washing action is present.

Paper machines trying to use two separate oil circulating systems were found to be unsuccessful due to the leakage from one system to the other. The leakage was found to be as large as fifty gallons per day.

Lubrication of Main Propulsion Power Plants Aboard Ship—By F. J. Hanly, Research Engineer, California Research Corporation.

Submitted by S. R. Calish, Secretary, Northern California Section ASLE

The primary functions of the lubricants for the various types of marine drives currently used in the United States, are: 1. Reciprocating steam engine; 2. Steam turbine; 3. Diesel engine.

The steam cylinder oil must be able to lubricate in the presence of water, maintain a fluid film at high steam temperatures and pressures to seal and lubricate moving parts under load, wet metal surfaces readily in the presence of water, atomize rapidly and minutely, resist the destructive action of high temperatures, and, when these tanks are completed, to separate readily from exhaust steam and condensate. A highly refined, paraffinic stock containing an oiliness or fatty material has been traditionally used for reciprocating steam engine lubrication.

Steam turbine lubricating oils, on the other hand, are not directly exposed to as many deleterious influences as steam cylinder oils, but they are expected to function unchanged for years, while reciprocating steam engine lubricants are usually applied on a once through basis. Steam turbine oils, in addition to performing their function as journal bearing lubricants, may be required to act as gear lubricants and hydraulic media. As such, they must be highly stable oils with a maximum of resistance to oxidation and should include a corrosion inhibitor and a foam inhibitor. In order to keep the oil system as dry as possible, the lubricant should separate from water rapidly and a positive means of venting the vapor space should be supplied.

The diesel engine, as applied to marine service, may be of two types. In the Merchant Marine, the large, slow speed engine is preferred, mainly because this engine is relatively simple in operation and is insensitive to fuel variations and to a lesser extent to lubricating oil. The Navy, however, prefers the smaller, higher output, high speed diesel engine which is quite fuel sensitive and demands a highly compounded, heavy duty type lubricating oil. A great deal of benefit may be shown through the use of the latter type oil in even the slow speed diesel engine in some types of service. Modern diesel engine lubricants possess a high degree of oxidation stability, detergency, corrosion protection and lubricating ability.

To obtain the optimum value from any lubricant, contamination of the oil system must be minimized and controlled.

Bearing Metals — Their Properties and Uses—By H. L. Smith, Executive Technical Engineer, Federated Metals Division of American Smelting & Refining Co., Pittsburgh, Pa.

Submitted by J. P. Halwachs, Secretary, Youngstown Section ASLE

Due to the illness of Mr. Smith, paper was presented by Mr. P. G. Bollinger, Sales Engineer, who discussed (1) the development of ferrous and non-ferrous bearing metals and their reduction in number from upwards of 400 in use prior to World War II to the present 6 alloys which actually give more satisfactory service when used in the application for which they were intended.

(2) The composition of the 6 alloys and their respective physical properties are numbered for ready reference to standard ASTM specifications. (3) Bearings used in present-day machinery fall into four major classifications: precision, those under 8" in diameter (automotive and diesel engines), spindles, etc.; large diameter flood-lubricated "precision" bearings, normally used for roll necks and large diesel or shaft turbine bearings; medium bearings, used on pumps, compressors, motors, turbine generators, finishing machines, etc.; and, loose fit bearings which include old-type and modern composition roll neck bearings, mine machinery, railroad, and old-style roll table bearings.

POSITION AVAILABLE

Mechanical or Chemical Engineer with several years experience as Lubrication Engineer to take charge of specifications and testing of lubricants for large manufacturer of high-speed electro-mechanical devices. Should have complete knowledge of petroleum and synthetic lubricants. Excellent opportunity. Location—New York State. Give information concerning education and experience in letter of application. Box No. 713.

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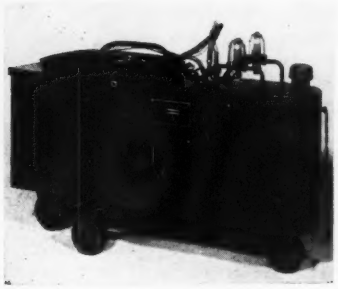
LUBRICATION IN THE NEWS



SPINDLE OILER: Model PSG-57 is designed to oil spindles without the use of dip gauges. The unit has a pressure and suction line mounted together and in a common control. The spout is adjustable for getting the exact depth of oil desired in the spindle base.

The oil level may be changed by manipulation of the valve. Hand controls are available for any type spindle that operates in the same manner as the marquette type.

Brown-Dynalube Company
203 Coddington Bldg., Charlotte, N. C.

DRAWING COMPOUNDS: Announcement is made of the publication of a bulletin describing the "TEN" Series of Drawing and Stamping Lubricants. These lubricants are designed for drawing, forming, stamping, cutting and piercing of stainless steel and other hard metals. It is claimed, that the lubricants possess great clinging and heat-resistant qualities, contain no fatty acids, will not separate out or go rancid.

The "TEN" Series consists of several wax lubricants, compounds, oils and pastes with different viscosities, grades and characteristics for various types of applications. Write for bulletin No. 10-25.

Forbex Corp.
125 Broad St., New York, N. Y.

PLANNED LUBRICATION: Information presented in a new 20-page bulletin on Keystone specialized lubricants includes lubricant characteristics, benefits, uses, densities, specifications and container sizes. Products covered are lubricants for ball and roller bearings, plain and ring bearings, open gears, enclosed gears, speed reducers, and oils for cleaning, loosening and penetrating. Copies of bulletin BK-19 can be obtained by writing to:

Keystone Lubricating Co.
21st, Clearfield & Lippincott Sts.
Philadelphia 32, Pa.

PRODUCTION GUIDE: A 52-page bulletin based on defense production experience gained from World War II and suplemented with the latest manufacturing and processing techniques is being released by Houghton, entitled "Defense Production Data From the Houghton Line."

This illustrated booklet covers the heat treating and metal working operations involved in producing shells, rockets, guns, ammunition, aircraft parts, tank parts and other defense items. The publication has been designed as a guide for metal working plants which are now switching from consumer or industrial production to defense production. It is recommended as being particularly valuable to plants converting to defense work for the first time, or those operating with inexperienced personnel.

Due to the limited supply, distribution of this booklet is restricted to metal working plants filling defense orders.

E. F. Houghton & Co.
303 W. Lehigh Ave., Philadelphia 33, Pa.

ARO EXPANDS: Pyles Industries, Inc., of Detroit, Mich. has been purchased by Aro Equipment Corp. It will be operated under its original name as a subsidiary of Aro. Pyles Industries is a manufacturer of industrial equipment such as heavy-duty pumps, metering devices, flow guns and special equipment for handling industrial lubricants.

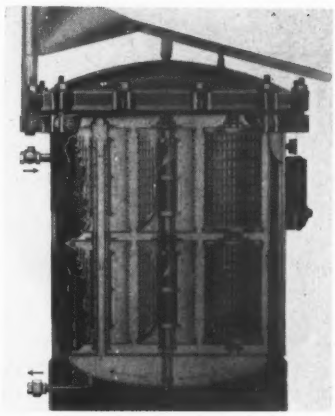
The acquisition of Pyles Industries gives Aro a complete line of industrial equipment to complement its already broad line of lubricant dispensing apparatus.

Manufacturing facilities and sales offices of the Subsidiary will remain in Detroit.

The Aro Equipment Corp.
Bryan, Ohio

MOLYKOTE LUBRICANTS: Bulletin 93 describes the industrial application of Molykote lubricants, citing case histories in various applications, including machine tools, dies, press fittings, threaded connections, taps, extreme pressure lubrication, cold forming, cold heading, instruments and others. The bulletin is available upon request.

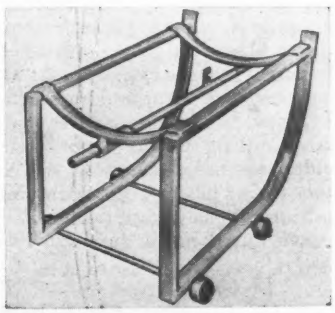
The Alpha Corp.
179 Hamilton Ave., Greenwich, Conn.



OIL FILTERS: Announcement is made of an improved line of the Hilco Hyflow lubricating fuel and industrial oil filters, including swing-bolt head construction for quick-opening of filter covers and a lifting device for ease of handling. Filtering materials are available for straight-run mineral oils or the heavy-duty detergent types.

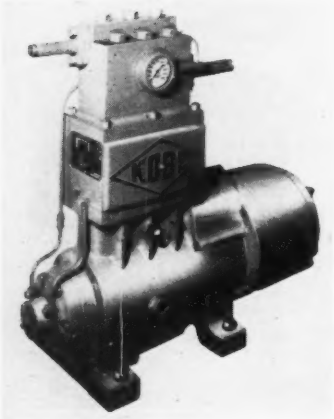
Unit capacities range from ½ gpm up to 1000 gpm for bypass filtering of diesel and gas engine lubricating oil and fuel oil. They are manufactured in stationary or portable designs and recommended for many industrial oils such as used in hydraulic equipment air compressors, steam engines, steam turbines and other types of lubricating or industrial oil used in machinery. For further information write the manufacturer.

Hilliard Corp.
171 W. Fourth St., Elmira, N. Y.



BARREL CRADLE: The steel barrel cradle though light in weight is strong enough for heavy loads. It is designed for the storing and draining of drums and barrels. The Barrel and Drum Cradle with "loading-bar" is said to permit the loading of drums with greater safety. For complete information write the manufacturer.

General Scientific Equipment Co.
2700 W. Huntingdon St., Philadelphia 32, Pa.



HIGH PRESSURE PUMP: Features of the recently introduced Kobe Triplex Pump include integral gears available in a wide variety of ratios. Plungers and liners are interchangeable, which provides a variety of pressure-volume ratings for each unit. Spring loaded balls and hardened-and-ground seats serve as inlet and outlet valves. Pressure lubrication is one of several built-in features which also include pressure gauge, relief valve and scavenger pump.

The unit is completely enclosed and manufactured in 15, 30 and 50 HP sizes with pressure ratings up to 5000 psi and displacement ratings up to 60 gpm. Special 10,000 psi and 20,000 psi heads are obtainable. For additional information write the manufacturer.

Kobe Inc., Div. of Dresser Equipment Co.
Huntington Park, Calif.

LABORATORY SERVICE: A new laboratory for testing the pumping and spraying qualities of such materials as coatings, adhesives, sealers and greases, has just been opened by Gray Co., Inc., in Philadelphia. The company, with plant and main office in Minneapolis, manufactures material-handling pumps, lubricating equipment and other products. Another testing laboratory is maintained in Minneapolis and a third will be opened in Atlanta in January, 1952.

The purpose of the laboratory is to furnish specialized data on pumpability and sprayability to manufacturers and users of fluids and semi-fluids, and to refiners of petroleum products.

Facilities of the laboratory are available to any company located in the New England, Middle Atlantic, South Atlantic and East South Central states. Address your request to

Gray Co., Inc., Testing Lab.
2124 Fairmount Ave., Philadelphia 30, Pa.

STEEL CLAMP: Series 21 Quick Coupling Clamp (Patents Pending), features a new hinged latch for quick assembly or removal and is designed for convenience in handling removable equipment. It is said to assure an efficient seal for all types of hose and duct connections. It is further stated that the unit has an extremely high strength-to-weight ratio, and is suitable for high temperature, pressure and corrosion resistance.

It is planned to manufacture this clamp to customer specifications, or to engineer them to specific requirements. Inquiries should be addressed to:

Fenton M. Davison, Specialty Products Co.
1965 E. 66th St., Cleveland 3, Ohio

PERSONALS

Edwin Crankshaw, Assistant Chief Engineer since 1946 for the Cleveland Graphite Bronze Co., has now become Chief Engineer for Product and Design with the same company.

Mr. Crankshaw is a member of ASLE, was formerly a Director of this Society, and is now its liaison representative to SAE. He is affiliated as a member of other technical societies such as ASME and SAE.

Mr. Crankshaw is active in the Cleveland Section of ASLE and has contributed liberally of his time and knowledge to the furtherance of the Society's activities.

We are happy to announce his new position to his many friends.

Overseas Visitor, Monsieur H. Serey, representing Societes des Huiles Renault, Issy-les-Moulineaux (Seine), France stopped in at the National Office before returning to France after a rather lengthy stay in the United States.

Monsieur Serey expressed great interest in LUBRICATION ENGINEERING and the value of its editorial content.

It is always pleasant as well as instructive — this mutual international exchange of information on our subject.

Lubrication Engineering Summer Course

Georgia Institute of Technology will, in 1952, conduct a two-week summer course on the theory and practice of lubrication. The series of studies will be open to any individual whose work interest lies in the field of lubrication. Since all lubrication engineering education is at present available only at the graduate level, this course will be designed to include the man with engineering experience who has not necessarily attained an engineering degree.

While the curriculum followed in this course will be substantially the same as that given at M.I.T. last June, there will be some changes as a result of a thorough field survey made during the past year.

Directed by Professor Joseph P. Vidosic with the cooperation of ASLE, other members of the Society, noted specialists in their respective fields, will serve as lecturers.

Plans for this course are now in progress. Full details regarding the subjects, lecturers and all pertinent registration information will be announced on the Lube Lines page in the February issue of this JOURNAL.

NEWS OF THE SECTIONS

We feel that much of the editorial content appearing previously in this feature has missed "striking oil" because it was limited and confined by its very heading.

Accordingly, digests and summarizations which your editors feel will contribute to the general knowledge and "know-how" of lubrication will now be featured in a section of its own, Lubrication Summarized.

The Sections are aware of these plans and we gratefully acknowledge their assistance in the inauguration of the new feature in the current issue of LUBRICATION ENGINEERING.

Your further suggestions and comments are invited.

CINCINNATI

By D. W. Moore, News Reporter

"Paper Mill Lubrication," by W. S. Miller, Gulf Oil Corp. — October meeting.

(SEE *Lubrication Summarized*)

L. B. Sargent, Physical Chemist of the Central Lubrication Committee of Aluminum Company of America, discussed the Committee's functions, activities and the working mechanism of the Lubrication Program at Alcoa at the September meeting.

This Committee establishes policies and determines projects for research and development concerning the Lubrication Program. Alcoa has installed their own coding system for all lubricants being used, thereby eliminating entirely the use of "brand names." Since 1940 when Alcoa started their Lubrication Program the number of lubricants was reduced from 850 different types then in use to their present number of 125.

SPRING SCHEDULE 1952

Meeting Held 1st Tuesday Each Month Cincinnati, Ohio

February 5: "Lubrication — Refrigeration Machinery"—Donald Lynch, G. E. Co.
March 4: "Lubricating Greases" — T. G. Roehner, Socony Vacuum Oil Co.
April 1: "Drawing Compounds"— Speaker to be announced (Ford Motor Co.)
May 6: "Lubricants Disposal and Storage"— Speaker to be announced.

EVANSVILLE

By R. C. Garretson, Chairman

SPRING SCHEDULE 1952

Meeting Held 3d Thursday of Each Month at Central Turners, Inc., 720 So. 8th St., Evansville, Ind. Social Hour: 6:30 P. M. Dinner: 7:00 P. M. Technical Session: 8:00 P. M.

January 18: "The Importance of Lubrication to Management"—H. C. Daseler, Staff Asst., International Harvester Co., Evansville Works.
February 21: Lubrication Problems in Diesel and in Internal Combustion Engines.
March 20: Practical Maintenance of Hydraulic Systems.
April 17: Reclamation and Disposal of Lubricants.

PITTSBURGH

By M. C. Miller, Secretary

"Some Industrial Experiences With Synthetic Lubricants," by C. H. Sweatt and T. W. Langer.—September meeting.

(SEE *Lubrication Summarized*)

DETROIT

By E. S. Kelly

"Application of Lubricant," by R. C. Lohbauer, Spicer Mfg. Div. of Dana Corp. This paper was delivered before the Section last year. However, it was felt that the information it contained was of sufficient value to be published.

(SEE *Lubrication Summarized*)

SPRING SCHEDULE 1952

January: "Cutting Fluids—Types and Uses" —Prof. O. W. Boston, College of Engineering, University of Michigan.
February: "Hydraulic Fluids"—Speaker to be announced.
March: "Application of Lubricants"—Speaker to be announced.
April: "Friction Bearings"—Speaker to be announced.
May: "Why Heavy Duty Motor Oils?"— Speaker to be announced.

Ed. Note: We regret that space does not permit publishing the excellent photos of this Section's Annual Stag Outing.

LOS ANGELES

By E. A. Mohr, Secretary

"Cutting Fluids and Their Contribution to the Defense Effort," by W. H. Oldacre, President, D. A. Stuart Oil Co.—October meeting.

(SEE *Lubrication Summarized*)

CONNECTICUT

By J. S. Martin, Secretary

SPRING SCHEDULE 1952

Time: Dinner 6:30 P. M. Technical Session: 8:00 P. M.

January 23—The Burritt Hotel, New Britain. Rust Prevention.
March 26—The Colonial House, Hamden. Lubrication.
May 14 — The Burritt Hotel, New Britain. Subject will be announced later.

Greetings, Kansas City

After several months of work on the part of the organization committee headed by Ralph Matthews and Nick Bath, the July flood catastrophe notwithstanding, a meeting was held at Hotel President in Parlor No. 221, on the night of October 15, 1951. Approximately 35 members and guests were present with National Secretary Leonard officiating as the temporary chairman. It was unanimously voted to establish a Section of ASLE in Kansas City.

After election of officers (see Section officers listing), the meeting was turned over to the newly elected chairman, Mr. Ralph R. Matthews. Various committees were appointed and preparations were under way that evening for their first technical session, which was held in November.

The Organization Meeting received publicity from the local *Kansas City Star,* as a result of which several additional new memberships were accepted.

Our readers will note that in thus welcoming Kansas City as the latest addition to our growing list of Sections, we are featuring the city itself on our cover with the cover story on another page of this issue. This area has long felt the need for the establishment of a Section of ASLE and based on not only the enthusiastic comments at the Organization Meeting, but the growing number of memberships received since the formal opening, we predict for Kansas City assured success.

With the establishment of the Kansas City Section we are narrowing the distance between our Eastern and Mid-Western and the two California Sections.

BOSTON

By A. S. McNeilly, Secretary

"Keep 'Em Running," by C. H. Parks, Bullard Machine Co. — September meeting.

(SEE *Lubrication Summarized*)

SPRING SCHEDULE 1952

Meetings Held at Smith House, Cambridge, on Mondays Time: Dinner 6:30 P. M. Technical Session: 8:00 P. M.

January 21
March 24
May 19

A special meeting is planned for February 18 at the M. I. T. Graduate House. The theme of this particular evening will consist of a lubrication panel who will be available to discuss general lubrication questions.

NORTHERN CALIFORNIA

By S. R. Calish, Secretary

"Lubrication of Main Propulsion Power Plants Aboard Ship," by F. J. Hanly, California Research Corp.—October meeting.

(SEE *Lubrication Summarized*)

YOUNGSTOWN

By J. P. Halwachs, Secretary

"Bearing Metals — Their Properties and Uses," by H. L. Smith, Federated Metals Div. of American Smelting & Refining Co.—October meeting.

(SEE *Lubrication Summarized*)

BUFFALO

By W. H. Miller, Chairman
Section News Committee

"Bentone Lubricants, Their Development and Properties," by D. H. Compondu, The Warren Refining and Chemical Co.—September meeting.

(SEE *Lubrication Summarized*)

"Lubrication of Power Plant Equipment," by F. C. Linn, General Electric Co.—October meeting.

(SEE *Lubrication Summarized*)

The opening fall meeting of this Section was in the form of a welcome to the newly organized Ontario (Canada) group. A joint meeting of Buffalo and Ontario will be held at the Fischer Hotel, Hamilton, December 11, 1951. C. L. Miller of the Eastman Kodak Engineering Dept. will speak on "Sleeve Bearing Design and Lubrication."

PHILADELPHIA

By J. L. Beatty

We feel sure that the many friends of the late William P. Kuebler, who is well remembered for his devoted service to ASLE in numerous capacities, will be interested to know that a memoriam has been set up for Bill at the recent dedication of Camp Sunset Hill. The Camp has been opened for the Girl Scouts in Delaware County in Pennsylvania.

The site was purchased by the Girl Scouts from the proceeds of the sale of their cookies and in tribute to Bill, who served as the first Treasurer 1934-41 and as a member of the Advisory Committee, 1941-46, a living Christmas tree is planted in his memory in the center of the open area in the front of the main cabin.

We appreciate Mr. Beatty's advising us of this very fine gesture on the part of the Girl Scouts.

BALTIMORE

By W. C. Kesler, Chairman
Programs and Meetings

SPRING SCHEDULE 1952

Meeting Held at Samuel Ready Auditorium, Sears Community House, North Ave. and Harford Rd., Baltimore, Md. Time: 8:00 P. M.

January 25: "Lubrication of Electrical Rotating Equipment"—G. L. Sumner, Lubrication Engineer, Westinghouse Elec. Corp., East Pittsburgh, Pa.

February 29: "A Practical Approach to Hydraulic Fluids"—C. R. Schmitt, Manager, Lubrication Sales Dept., E. F. Houghton & Co., Philadelphia, Pa.

March 27: "Chemical Addition Agents for Lubricants"—W. D. Thomas, Jr., Tech. Rep., Petroleum Chemical Dept., Industrial Chemicals Div., American Cyanamid Co.

April 24: "Oil Crankcase Analysis as an Aid in Lubrication of Internal Combustion Engines"—W. C. Landis, Manager, Lubricants Dept., Shell Oil Co., Baltimore, Md.

May 24: "Annual Business Meeting and Banquet"—Details to be announced later.

The Program designed by Baltimore (Calendar of Events), is the first of its kind to cross our desk. It is issued prior to a meeting and consists of eight pages with cover, listing the Section Officers, Committees and Chairmen, a Directory of the Members, a complete Calendar of Events for the entire season, an outline of the purposes of the National ASLE, and the Baltimore Section as well, a description of the current meeting with a photograph, biography of the speaker and an abstract of his talk.

It is sustained by paid advertising from companies representing lubricants and lubrication devices. The Program is a finished job of makeup and printing and an idea that might well be emulated by other Sections. Certainly it should be an assist in increasing the attendance of members at the meetings, as well as increasing the growth of the Section itself.

The editors of LE doff their toppers to Baltimore.

SAGINAW VALLEY

This Section has inaugurated a small folder type notice entitled "Lubri-Gram." It contains comments on meetings, past and future, salient information of interest to members of their group and is not only well written but consists of excellent editorial content. The issuance of the folder is made possible through the contributions of some of the local members and their companies.

OUR COVER

Kansas City is the largest city in the vicinity of the exact geographical center of the United States, and is the gateway to the West and Southwest, with 12 trunkline railroads going to and from "The Heart of America."

In June, 1850, the town of Kansas received its first charter of self-government and it is the 100th anniversary of that event that K. C. celebrated in 1950.

Agriculture and livestock have long furnished the raw material for its leading industries. The meat packing industry, as a whole, closely linked with the livestock business, is a basic industry in Kansas City and of major importance. There exists a fine balance between industry and agriculture.

Its cultural assets are worth a city many times its size (1950 U. S. Census — 808,243). Two of the city's "notables" are the Philharmonic Orchestra and the Midwest Research Institute.

A Section of ASLE has recently been organized in Kansas City. The group reflects the forward looking spirit of the city.

NORTHERN CALIFORNIA

By S. R. Calish, Secretary

PROPOSED FUTURE PROGRAM

1951

Dec. 12: Representative of Owens-Corning-Fiber-glass will speak on Lubrication in Their Industry

1952

Jan. 9: Shale Oil and Its Prospects

Feb. 20: Proposed Joint Meeting with the SAE—Fuels and Lubricants Meeting

Mar. 12: "Friction and Wear"—A. C. West, California Research Corp.

Apr. 9: A representative of the lubricant dispensing industry will speak

May 14: Problems of Lubrication of Public Transport Equipment

June 11: Military Lubricants

ATTENTION ALL SECTIONS

When submitting Section Papers for publication in LUBRICATION ENGINEERING it is necessary that we receive 4 copies. This facilitates efficient handling.

—ED. NOTE

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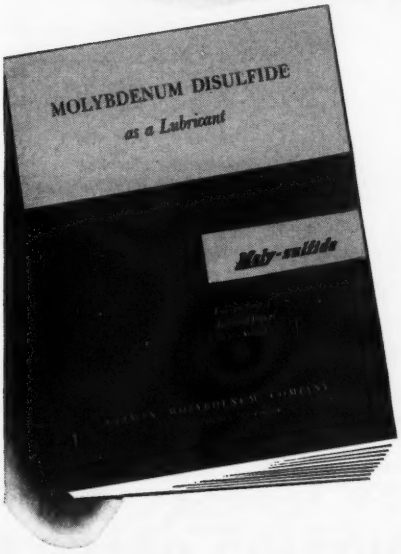

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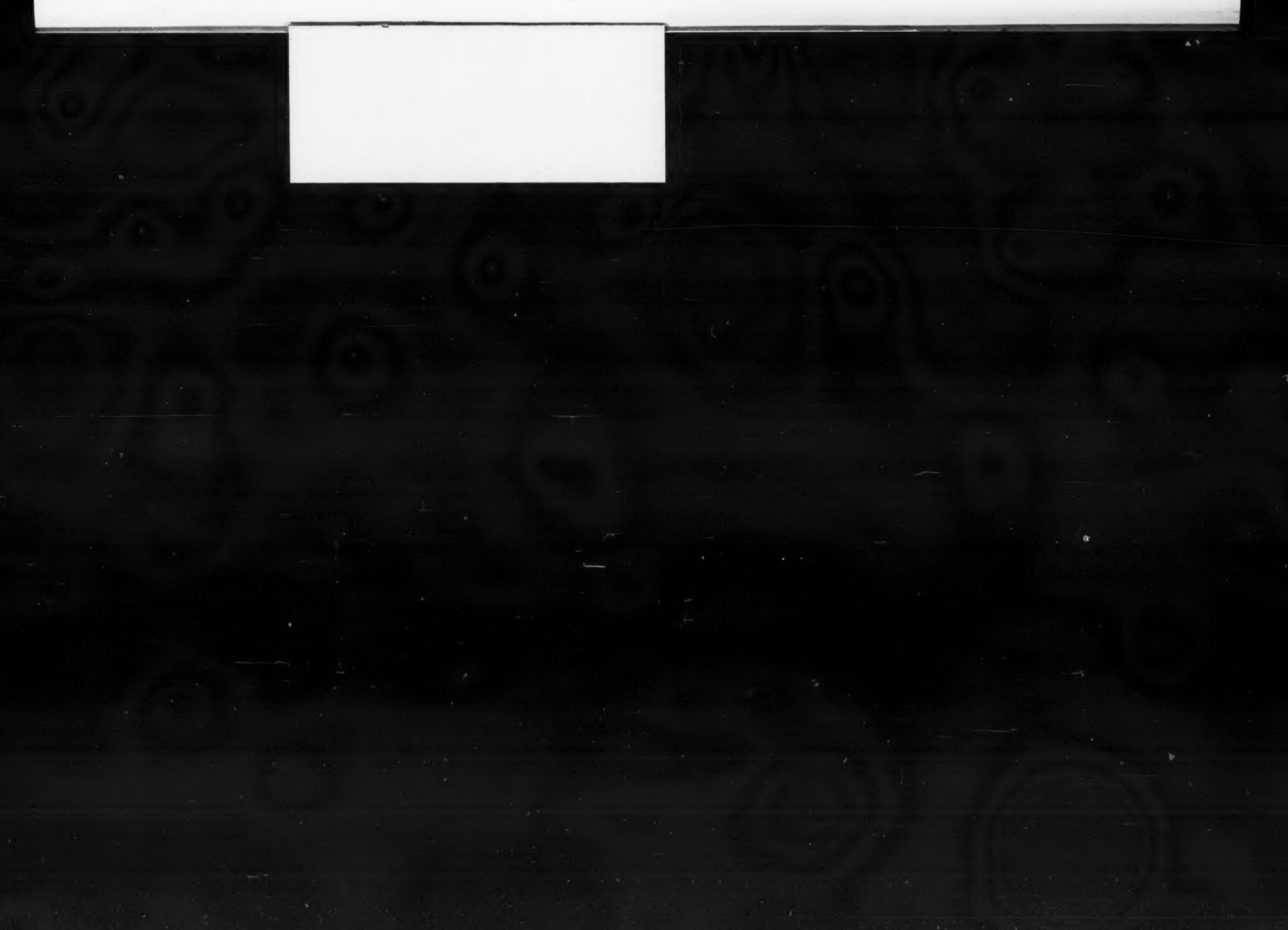

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Hi-Lites of the 33 papers and 3 symposia to be presented:

FLUIDS FOR METALS WORKING—C. M. Larson (Sinclair) to present a paper on the practical aspects of cutting fluids. . . . Blade wear and tool life results with cutting fluids in carbide steel milling reported by J. R. Roubik (Kearney-Trecker).

GREASES—G. Grant (Dow Corning) to review extensive program on design considerations for the optimum performance of silicone greases. . . . Fundamental knowledge of lubricating grease structure will be discussed by B. W. Hotton (California Research).

INDUSTRIAL TRUCKS—The fundamentals of lubrication maintenance of electric and gasoline driven industrial trucks will be the subject of a paper by A. E. Dorod (Baker Industrial Truck).

FRETTING CORROSION (FRICTION OXIDATION)—D. Godfrey and E. E. Bisson (NACA) will report on some studies of the mechanism of surface damage by fretting. This presentation will be highlighted by an unusual color film showing actual fretting of steel against glass.

OIL FOG LUBRICATION—A discussion of the applications of oil fog lubrication and a review of extensive research into the behavior of lubricating aerosols will be covered by D. G. Faust (C. A. Norgren).

GEAR LUBRICATION—A discussion of lubrication and load carrying capacity of gears by E. T. Hutt (Shell-Thornton Research Center) will offer a keen insight into the problems in predicting gear and gear oil performance.

AIRCRAFT ENGINE LUBRICATION—Lt. L. D. Christensen (USAF Wright Air Development Center) will summarize work done to date on high performance lubricants for turbo-jet and turbo-prop lubricants and emphasize areas where additional research is required.

LUBRICANT CLASSIFICATION—A novel system developed by C. A. Bailey (National Tube) to overcome problems encountered in the identification of lubricants purchased under brand names and specifications will be reviewed.

LUBRICANT EVALUATION—A discussion of some newly developed equipment for evaluating oils and greases used in bearings and other applications will be given by R. J. S. Pigott (Gulf).

Watch for the Program Outline— a complete listing of papers—in the next issue

CURRENT LITERATURE

Corrosion, Vol. 7, No. 8, August, 1951

ON THE ANTI-CORROSIVE ACTION OF SOLUBLE CUTTING OILS

Ferri, A.—p. 166a
(Met. Ital., Vol. 42, No. 7, pp. 261-267, 1950)

The Institute Spokesman, Vol. 15, No. 5, August, 1951

FLOW PROPERTIES OF LUBRICATING GREASES

Marusov, N.—pp. 8-9, 11, 13-17, 19-22, 25, 27, 29

This paper describes an apparatus which may be used for pursuing studies of grease flow properties and illustrates with examples the scope of the tests possible, emphasizing the need for these studies. Figure 3 shows a schematic view, in section, of the instrument. Figure 6 shows the grease viscometer photographically with the thermal bath removed. Figure 14 illustrates a more complex thixotropic study of a sodium base grease at 200 F. A discussion by L. C. Brunstrum follows.

KEEPING UP TO DATE ON GOVERNMENT SPECIFICATIONS

Kelley, C. W.—pp. 30-31

The Munitions Board of The Department of Defense has the responsibility for coordinating petroleum specifications. It consists of the office of Petroleum Programs and the Standards Agency. The Standards Agency is charged with the responsibility of determining the procedure for the coordination of all specifications. This includes specifications for any item purchased by the services. The Office of Petroleum Programs on the other hand, is concerned with all matters pertaining to the military aspects of petroleum. Formerly specifications could be issued independently by almost any branch, bureau or activity of the services. Such independent action has been largely eliminated since the new system has been put into effect.

No. 6, September, 1951

MULTI-PURPOSE GREASE PROFITS PLUS SIMPLIFICATION

Sommers, A. C.—pp. 8-11

The authors, accepting the chemical and physical properties of multi-purpose greases as indicated by technicians, attempted to make the grease work under their own conditions of marketing and customer service. The results were satisfactory. A discussion by H. L. Hemmingway follows.

THE STRUCTURE OF ALUMINUM GREASES

Dean, W. K.—pp. 12-13, 15, 17, 19, 20-21

This paper comprises an attempt to bring together some of the ideas advanced to date and to use them in explaining the formation and properties of aluminum greases. A bibliography is included.

WIRE ROPE LUBRICATING GREASES

Anon.—p. 25....

The lubrication of wire ropes and cables presents peculiar problems. In U.S. patent 2,556,289, Standard Oil Development Company discloses a preferred composition for this purpose which comprises a mineral base oil of 35-200 SSU. viscosity at 210 F. with a thickener, a rust inhibitor, an extreme pressure additive, and a stabilizer. The thickener is preferably 3-15% by weight of an alkali metal soap of C_{12}-C_{22} fatty acids, preferably saturated. The rust inhibitor is a combination of an oil-soluble petroleum sulfonate and an animal wax or ester such as degras, about 1-5% by weight of sulfonate of 400 or higher molecular weight, with 1-5% of degras. About 1-10% of lead oleate is added for extreme pressure and oiliness properties, along with 3-12% of a sulfurized oily product, such as sulfurized hydrocarbons, fatty oils, ester waxes, etc., provided they are not corrosive to ferrous metals.

No. 7, October, 1951

GRAPHITE AS A LUBRICANT

Glauch, E. S.—pp. 8-11, 13, 15

(Reprinted from *Iron and Steel Engineer*, August 1951)

The first use of graphite as a lubricant is lost in antiquity. The name "graphite" was first given to the mineral by the mineralogist Werner in 1789. It is also known under other names such as blacklead, silver lead and plumbago. Graphite, one of the softest minerals, has a hardness of ½-1½ on Moh's scale. Graphite is now being used throughout industry for a multitude of purposes. It is unctuous, a feature which often results in the reference "greasy" to be applied to graphite, although it is free from oil or grease in its original form. Graphite marks readily, burns slowly and is almost chemically inert. There are three distinct forms of natural graphite: flake, vein and so-called amorphous. A discussion of the paper by C. E. Pritchard, E. S. Glauch, D. E. Whitehead, J. F. Boal, V. A. Crosby follows.

Journal of the Institute of Petroleum, Vol. 37, No. 331, July, 1951

THE WORK AND PROGRAM OF SUB-COMMITTEE No. 12. GREASES

Ellis, E. G.—pp. 358-372

This sub-committee of the Institute of Petroleum has studied the following subjects: corrosion test for lubricating greases, free alkali and free acid in greases, oil separation on storage of grease, foreign particles in greases, melting point of petrolatum, drop point of greases, oxidation stability of lubricating greases by the oxygen-bomb method, tests for the assessment of the behavior of greases in anti-friction bearings at subzero temperatures, mechanical stability tests, the development of a bearing-rig test for the evaluation of anti-friction bearing greases, modification of the penetration method, cone-resistance test, consistency measurements on small samples, and measurement of apparent viscosity. Discussion is included..

Lubrication (Texas Co.), Vol. 37, No. 8, August, 1951

THE HEAVY-DUTY AUTOMOTIVE VEHICLE ASSEMBLY

Anon.—pp. 85-96

Machinery used in line production of heavy-duty vehicles is of particular interest to the lubrication engineer. Faulty lubrication can cause malfunctioning and slowdown. More important, failure of any part due to continued faulty lubrication can cause production stoppage. In view of prevailing use of pressure gun lubrication, suitable fittings must be installed on the bearings for attachment of the gun when relubrication is necessary. This method of pressure lubrication is highly efficient in protecting bearings capable of retaining a grease charge without leakage. A grease for ball or roller bearing lubrication must be practically free from acid-forming tendencies. A conveyor motor or air-hoist out of service due to bearing trouble can upset the best laid production plans. Careless handling may cause dust and dirt trouble. Automatic lubrication by air line oilers or atomizers mechanically delivers the right amount of clean oil to air lines. This type of lubricator prevents oil contamination from exterior sources if fresh oil is kept clean. Air tools must be periodically oiled by hand. There is more possibility of accidental entry of dust or dirt under these conditions.

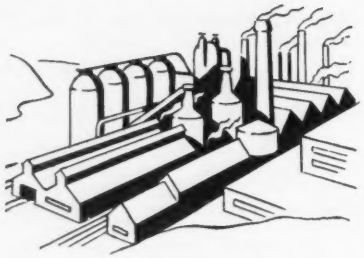
Oilways (ESSO), Vol. 18, No. 4, October, 1951

SOLVING PROBLEMS WITH CARUM

Anon.—pp. 12-14

Carum Lubricants are special-purpose types which are resistant to the action of acids, hydrocarbon fuels and solvents. Certain grades are specially useful in lubricating valves, pumps and other devices handling nitric and other acids, natural gas and hydrocarbon solvents. There are 4 types (Carum 35, 40, 165 and 200). Carum 35, tan, soda-base, smooth-textured but stiff grease, with a dropping point of 175 F. has property of being highly resistant to the action of natural gas, kerosene, gasoline, toluol, xylol and other hydrocarbon solvents. Carum 35 is somewhat affected by acetone, ethyl acetate, methyl-ethyl-ketone and other powerful oxygenated solvents. It can be effectively used as lubricant for bearings and stuffing boxes of pumps handling hydrocarbon solvents and other hydrocarbon products. Carum 165 is dark gray, contains graphite, is softer, less resistant to hydrocarbon solvents. Its use is restricted to 35 F. and 180 F. The graphite content of Van Carum 165 makes it undesirable for use in anti-friction bearings. It is desirable, however, in packing for which a graphited lubricant is indicated. Carum 200, a white-colored tacky, non-soap grease, is designed for use in pumps and equipment handling nitric and other acids. Another white-colored grease is Carum 40, aluminum-soap product of smooth texture and adhesive properties. It may be effectively used in food processing plants. Bearings, stuffing boxes, open gears, conveyor parts and other elements can be effectively lubricated with Carum 40.

(*Continued on page* 298)



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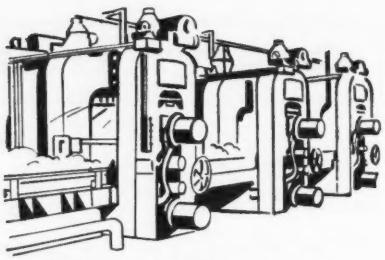

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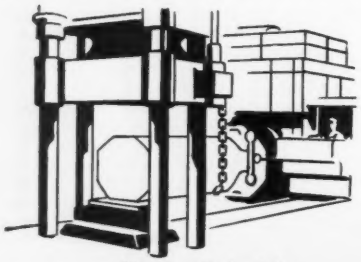

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Physical Properties of Lubricants:
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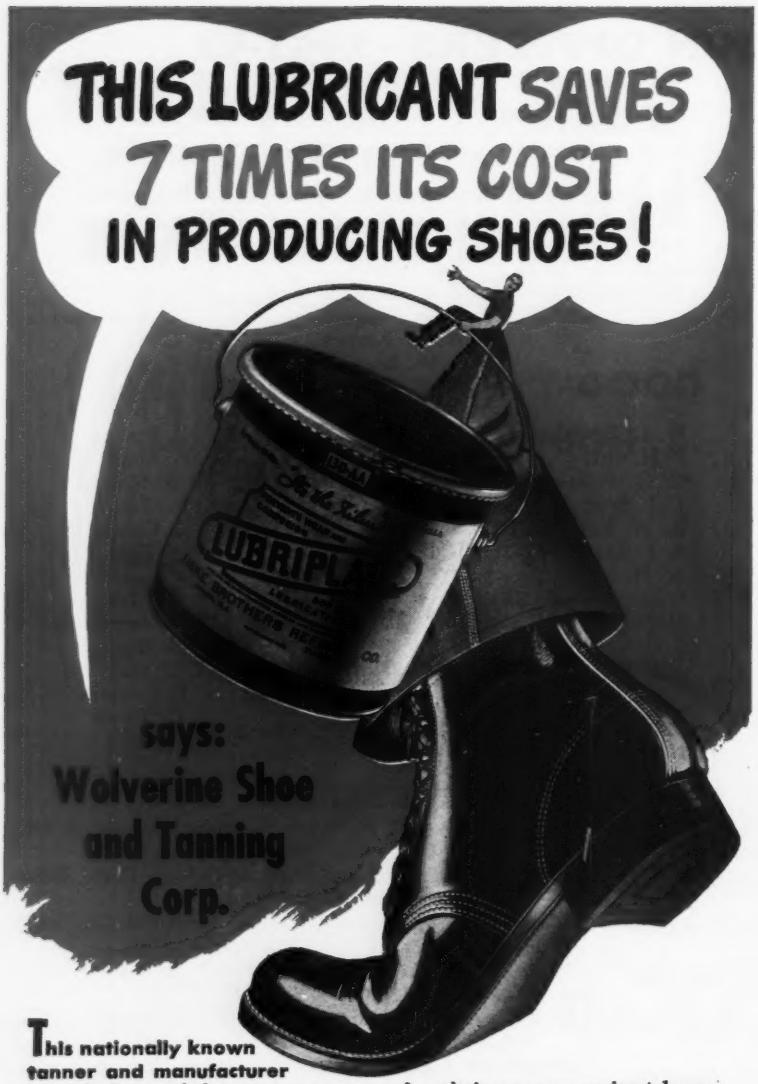

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CURRENT LITERATURE

(*Continued from page* 295)

***Petroleum Refiner*, Vol. 30, No. 8, August, 1951**

USE A CARRYING CASE TO CLEAN LUBRICATORS

Anon.—pp. 92-93

As individual pumps in force-feed lubricators require a certain amount of maintenance, repair and cleaning, the down time of the machine to which the unit is attached can be cut to a minimum by supplying spare pumps in the engine room for quick replacement. A tinsmith can construct an adequate container to be carried from the shop to the engine room, or to any one of the engines where replacement of lubricator parts is required.

***Petroleum Times*, Vol. 55, No. 1408, July 27, 1951**

PROGRESS IN THE SCIENCE AND ART OF LUBRICATION

Paterson, E. V.—pp. 666-668

This quarterly review of developments in lubrication considers bearing materials, molybdenum-coated metals, a new seal face material known as "Lacrinite," lubrication of wire drawing dies, preventive maintenance, lubrication testing, a new grease named Hypermatic, fire protection, and the 3rd World Petroleum Congress.

CONTRIBUTION TO THE STUDY OF THE PRODUCTS OF ALTERATION OF A LUBRICATING OIL EFFECTED BY APPROPRIATE EQUIPMENT

Mastsas, E.—p. 674

This paper gives a brief account of work designed to draw up an appropriate preliminary treatment for a used oil in order to secure, by physico-chemical and chemical means, an elimination of compounds maintained in colloidal suspension, and also to devise a convenient apparatus for the fractionation of used oil.

LUBRICATING OILS IN THE INTERNAL COMBUSTION ENGINE

Dewdney, D. A. C., Evans, E. B., Heaton, J. L., and Hunt, K. C.—p. 674

The various lubrication requirements of the three main classes of internal combustion engine are discussed in turn, with particular reference to the development of the use of additives for improving pour point, viscosity index, detergency and corrosion and oxidation resistance.

***Plant Engineering*, Vol. 5, No. 9, September, 1951**

GREASE TESTER

Anon.—pp. 24, 26

An electric motor grease tester was designed and constructed at the Naval Engineering Experiment Station, Annapolis, Md., to test shipboard electric motor greases for large bearings operated at slow speeds under heavy loads. Apparatus is described.

"CATERPILLER PROGRAM" FOR ADDITIVE OIL SPECS

Anon.—pp. 88-89

Caterpiller Tractor Co. investigated additive-type hydraulic oils in 1945 to

revise specifications for heavy duty oils. Investigation included laboratory bench tests, pilot machine test, and full-scale plant test. Oils were tested singly and mixed with each other. New specifications were written for each of the viscosity grades required and all hydraulically-operated machines that were in good condition were changed over to the additive-type oil. Caterpiller's specification sheet for medium hydraulic oil is shown.

Revue De L'Institut Francais Du Petrole Et Annales Les Combustibles Liquides, Vol. 6, No. 7, July, 1951

MOLYBDENUM LUBRICANT PROVES ITSELF IN TOUGH TESTS

Sonntag, A.—pp. D113-D114
(Iron Age, Vol. 167, No. 6, pp. 91-94, 1951)

The author has previously pointed out the excellent lubricating properties of molybdenum disulfide. In the present article he takes up the use of this lubricant in connection with handling a press (pressure 700 kg per cm^2 between the two parts). The operation was carried out with a Baldwin hydraulic press. The structure of the lubricant is laminar. It is not affected by low temperatures.

A B C OF LUBRICATION

Anon.—pp. L53-L60

This installment, following previous installments, takes up conversion of viscosity at different temperatures, several graphs being included. A viscosity graph covering temperature—pressure data of lubricating oils by J. L. Groff is included.

THE ABC OF LUBRICATION

Anon.—pp. L45-L52

This article continues the subject of lubrication begun in previous installments. Viscosity, plasticity and pseudo plasticity are taken up. Special viscosity problems of lubricating oils are considered. Viscosity curves, showing viscosity as a function of the temperature, are taken up and other formula for viscosity-temperature are considered.

Scientific Lubrication, Vol. 3, No. 8, August, 1951

WIRE ROPE LUBRICATION PART 3 APPLYING THE LUBRICANT

Anon.—pp. 20-23

The first two parts in this series dealt with the importance of correct lubrication for wire ropes, and the type of lubricants suited to do the job, respectively. The present installment deals with the application of rope lubricants and methods found successful. Some of these are contained in a booklet issued by The Aerial Ropeways Assoc. There are obviously two methods of applying rope lubricant, by hand or automatically. Lubricant can be applied by hand whenever this is not a laborious duty. Shortest ropes cannot be lubricated correctly by hand. An automatic, or better, a semi-automatic method may be used. For automatic lubrication of short continuous bicable ropes, the British Ropeway Engineering Co., Ltd., supply a lubricator. Another method more applicable to longer ropes, is made by R. White & Sons Ltd., Widnes, and in this, the pump and oil are carried in the bucket.

(*Continued on page* 302)

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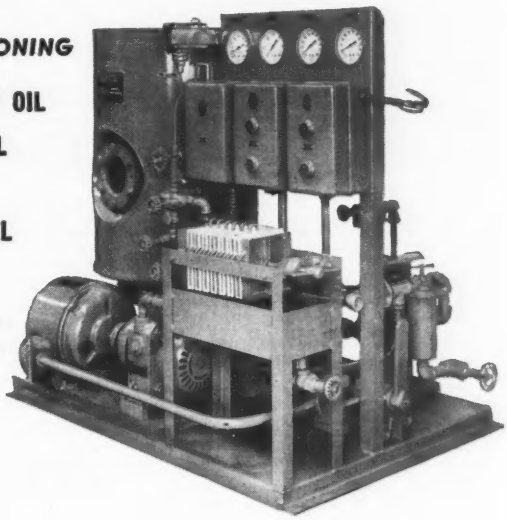

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OILS AND LUBRICANTS
PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 648, Nos. 1, 2, 3, 4, 5; Vol. 649, Nos. 1, 2, 3, 4.

PREPARED *by* ANN BURCHICK

Method of Processing Solvent-Extracted Lubricating Oil by Treating with Phosphorus Pentasulfide and a Base and the Resulting Products—Patent #2,560,546—John D. Bartleson, assignor to The Standard Oil Co.

A method of further processing solvent-extracted lubricating oil stock consisting essentially of hydrocarbon material to yield an oil having improved inhibition to oxidation in service, which method comprises treating said stock with an amount of phosphorus pentasulfide in the range of about 0.1 to about 0.75% by weight at a temperature in the range of about 275 F. to 450 F., and then with an amount of a base in the range of about 0.25 to 6.0 equivalents per mol of the phosphorus pentasulfide.

Method of Processing Lubricating Oil by Treating with Sulfuric Acid, A Phosphorus Sulfide and a Base and The Resulting Products—Patent #2,560,547—John D. Bartleson, assignor to The Standard Oil Co.

A method of processing lubricating oil stock consisting essentially of hydrocarbon material to yield an oil having improved inhibition to oxidation in service, which method comprises treating said stock with sulfuric acid in a conventional manner, then treating the resulting acid-refined hydrocarbon with an amount of phosphorus sulfide in the range of about 0.1 to about 0.75% by weight at a temperature in the range of about 275 F. to 450 F., then with an amount of a base in the range of about 0.25 to 6.0 equivalents per mol of the sulfide, and including at least one separate clay-treating step subsequent to the acid-refining step.

Method of Processing Solvent-Extracted Lubricating Oil by Treating with a Phosphorus Sulfide, A Base and Clay and the Resulting Products—Patent #2,560,548—John D. Bartleson, assignor to The Standard Oil Co.

A method of further processing solvent-extracted lubricating oil stock consisting essentially of hydrocarbon material to yield an oil having improved inhibition to oxidation in service, which method comprises treating said stock with an amount of phosphorus sulfide in the range of about 0.1 to about 0.75 % by weight at a temperature in the range of about 275 F. to 450 F., then with an amount of a base in the range of about 0.25 to 6.0 equivalents per mol of the phosphorus sulfide, and including at least one separate clay treatment subsequent to the sulfide treatment.

Mineral Oil Containing Polymers of Esters of Fumaric Acid—Patent #2,560,588—John C. Munday and Dilworth T. Rogers, assignors to Standard Oil Development Co.

A composition comprising a major proportion of a waxy mineral lubricating oil and a minor but at least pour point depressing amount of a polymer of fumarate alkyl ester composition having more than one distinct alkyl ester group having from 1 to 18 carbon atoms, at least one of said alkyl ester groups having a chain length in excess of 10 carbon atoms and all of said alkyl ester groups having an average of between 5 and 15 carbon atoms, said polymer having a molecular weight within a range of from 1,000 to 40,000 and having been prepared by first forming the fumarate ester and then polymerizing said ester in the basence of air.

Insecticidal and Fungicidal Spray Oil—Patent #2,560,626—Clifford J. Boissonou and Wallace J. Yates, assignors to Shell Development Co.

A water-emulsifiable insecticidal spray oil composition comprising a predominant amount of horticultural hydrocarbon spray oil having dissolved therein between about 0.01% and about 5% by volume of a fatty acid monoester of a polyalkylene glycol and a solublizing amount of an oil-soluble unsubstituted alkyl phenol, said ester having between about 14 and about 60 carbon atoms in the glycol portion and between about 12 and about 30 carbon atoms in the acid portion.

Mineral Oil Compositions Containing Polymers of Thiophene — Patent #2,560,956—George C. Johnson, assignor to Socony-Vacuum Oil Co.

A mineral lubricating oil containing a minor proportion, sufficient to improve the viscosity index of said mineral lubricating oil, of a polymer of a material selected from the group consisting of thiophene and monoalkyl thiophenes, obtained by contacting said material with a silica-alumina catalyst, at a temperature falling within the range varying between about 20 C. and about 200 C. and for a period of time varying between about 1 hour and about 20 days.

Mineral Oil Compositions Containing Petroleum Wax Carboxylic Acids—Patent #2,560,986—Frederick P. Richter, assignor to Socony-Vacuum Oil Co., Inc.

A mineral oil containing a minor proportion, sufficient to improve the detergent properties of the oil, of a metal salt selected from the group consisting of a barium salt and a magnesium salt of a product prepared by converting wax-like aliphatic hydrocarbon mixtures originating from petroleum oil and containing from 15 to 36 carbon atoms to the molecule into a mixture of the corresponding Grignard Reagents, treating the mixture of Grignard Reagents with carbon dioxide, and hydrolyzing the resulting salts with mineral acids to convert them into carboxylic acids.

Lubricating Oil Compositions Containing the Reaction Products of Diesters of Dithiophosphoric Acid and Pinene—Patent #2,561,773—Frederick B. Augustine, assignor to Socony-Vacuum Oil Co., Inc.

As a new composition of matter, a lubricating oil containing a minor proportion, sufficient to improve the characteristics thereof, including resistance against corrosion and sludge formation, of a product obtained from the reaction between a diester of dithiophosphoric acid and a pinene, said reaction involving about one mol of diester to one mol of pinene, with sufficient heat to complete the reaction.

Mineral Oil Compositions Containing Thienylthioalcohols — Patent #2,561,780—John W. Brooks, assignor to Socony-Vacuum Oil Co., Inc.

An improved mineral oil composition comprising a mineral oil and in admixture therewith a minor proportion, sufficient to stabilize said oil against the deleterious effects of oxidation, of a betathienylthoalcohol.

Lubricating Composition—Patent #2,562,144—Denham Harmon and George L. Perry, assignors to Shell Development Co.

As a new composition of matter the sulfurized reaction product obtained by heating 10 to 60 parts by weight of sulfur with a sufficient amount of polyether so that the total of sulfur and polyether is 100 parts by weight at a temperature between 100 C. and 250 C. for a time between 1 and 40 hours, said polyether boiling above 240 F. at 0.2 cm. mercury pressure and having a general formula

$$R_1\text{—}\left\{\text{—O—R—S—R—}\right\}_n\text{—O—R—SH}$$

wherein R_1 is an unsaturated aliphatic hydrocarbon radical, each R is a divalent aliphatic hydrocarbon radical and n is an integer.

Thiosilane Synthetic Lubricants — Patent #2,562,474—Bernard A. Orkin and Frederick P. Richter, assignors to Socony-Vacuum Oil Co., Inc.

A synthetic lubricant having a viscosity falling within the viscosity range of lubricating oils, a low pour point, a high viscosity index, and good stability, consisting essentially of the reaction product obtained by reacting a cyclic thiol selected from the group consisting of cycloalkanethiols, arylthiols, thienylthiol-2, thienylthiol-3, 2-ethylthienylthiol-3, and pyridylthiol-2, at least one alkanethiol, and a silicon tetrahalide, in a proportion of about one mole, about three moles, and about one mole, respectively, and at a temperature varying between about 80 C. and about 140 C.; the total number of carbon atoms and heterocyclic atoms present in said cyclic thiol and said alkanethiol varying between 20 atoms and 40 atoms.

Styrene, Fatty Oil Polyallyl Ether Copolymers — Patent #2,562,537 — John Robert Roach, assignor to General Mills, Inc.

A liquid, soluble copolymer comprising a principal quantity of an unsaturated fatty oil, and lesser but substantial quantities of a polyallyl ether and of styrene.

Lubricant Additive—Patent #2,562,776—Elmer B. Cyphers and Jeffrey H. Bartlett, assignors to Standard Oil Development Co.

A lubricating composition consisting essentially of a mineral base lubricating oil containing 0.02 to 20%, by weight, based on the total composition, of the oil soluble condensation product of a C_6 to C_{22} dialkylated dithiophosphate salt of alkali metal condensed at a temperature of about 100 to 200 F. with a copolymer C_6 to C_{22} aliphatic chlormaleate with vinyl acetate, said copolymer being produced at a temperature within the range of about 70 F. to 300 F. and having a molecular weight between about 1000 and 25,000.

Lubricant Composition of Mineral Oil Containing a Condensation Product of Aliphatic-Aromatic Ketone and a Sulfur Chloride—Patent #2,562,800—Eugene Lieber, assignor to Standard Oil Development Co.

A composition consisting essentially of a normally non-volatile hydrocarbon material and a pour depressing amount of a high molecular weight oil-soluble product obtained by reacting about 100 parts by weight of a ketone having the general formula R—CO—Ar, in which R represents an aliphatic group having more than 10 carbon atoms, and Ar is an aromatic group, with about 5 to 50 parts by weight of a sulfur chloride in the presence of about ½ to 15 parts by weight of a Friedel-Crafts catalyst at a temperature of about 80-200 F., to produce a high molecular weight but oil-soluble condensation product, hydrolyzing and removing the catalyst, and distilling the reaction product to obtain as distillation residue the desired high molecular oil-soluble product.

Wax Phenol Ester of Substituted Succinic Acid and Wax Mineral Oil Compositions Containing Same—Patent #2,562,808—Louis A. Mikeska, assignor to Standard Oil Development Co.

A product consisting essentially of a wax phenol ester of a substituted succinic acid, said substituent group being an unsubstituted long chain hydrocarbon group containing from 12 to 18 carbon atoms.

Sulfonate Lubricating Grease—Patent #2,562,814—Rosemary O'Halloran, assignor to Standard Oil Development Co.

A lubricating grease composition consisting essentially of a lubricating oil thickened to a grease consistency with a complex combined thickener of 5 to 20% by weight, based on the total composition, of oil-soluble metal sulfonate derived from a relatively high molecular weight petroleum sulfonic acid combined with 0.5 to 15% by weight of an oil-insoluble metal salt of relatively low molecular weight acid, and a structure modifier comprising 0.1 to 5% of an ester of polyhydric alcohol and organic acid of 12 to 24 carbon atoms.

(*Continued on page* 302)

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CURRENT LITERATURE

(*Continued from page* 299)

FIRST PRINCIPLES: A SERIES OF ARTICLES EXPLAINING IN SIMPLE LANGUAGE THE FUNDAMENTALS OF LUBRICATION NO. 21, PROPERTIES OF CUTTING OLIS

Anon.—pp. 27-28

The article details the principal properties required by a cutting oil, noting in each case the type of cutting oil to which each property has the greatest importance. These properties include:—thermal conductivity, wetting properties, lubrication, nonsmoking (and not giving bad odor), oxidation resistance, suitable viscosity (least possible to aid centrifuging), opaqueness and freedom from dermatitis.

VAPOUR BLAST IMPROVES LUBRICATION

Anon.—p. 28

Metal surfaces that have been vapour blasted, can be more easily and successfully lubricated. A recent development in connection with the above is announced by British Vapour Blast Ltd., Wellington, Shropshire. The process has been used for the surfaces of cylinder bores by one of their leading automobile manufacturers. The tests followed the occurrence of corrosion which tended to form when engines were standing for any length of time after their initial test run which lasts several hours. This rusting was thought to be due to condensation, probably due to corrosive compounds dissolved in the condensate.

No. 9, September, 1951

ONE-THIRD OF WORLD'S ENERGY MAY BE CONSERVED BY SUITABLE LUBRICATION

Anon.—p. 9

At the Third World Petroleum Congress various investigators discussed economy that could be obtained by proper lubrication. Among them was Vogelpohl, who gave an important paper on the subject.

MIXING CUTTING OILS

Hutton, H. W.—p. 23

The author comments on an article recently appearing (July issue of this journal) on "First Principles, No. 20, Cutting Oils." The author objects to a statement made, and says where emulsions of the oil-in-water type are referred to, it is usually the practice to pour soluble oil into the diluent as recommended. However, technically this is regarded as good practice in colloid chemistry and generally if the diluent (water) is poured into the oil with stirring, dispersion of the miscible particle is more uniform in size and orientation.

MORE LUBRICATION PROBLEMS OVERSEAS

Tong, R. W., pp. 24-26

The author discusses foreign problems in lubrication, especially occuring in South Africa. He takes up unreliable lubricators, lubricating exhaust valve spindle, Diesel fuel, mechanical lubricators, enclosed engines, pressure gauges, oil pumps, filters, distribution lines, draining, valve wear and position of gear wheels.

Service Factor (Sinclair Refining Co.), Vol. 16, Second Edition, 1951

LUBRICATION OF KNITTING MACHINES

Anon.—pp. 1-8

The characteristics of a good needle oil are:—lubricating ability (for light close-tolerance precision parts), rust prevention during shut-down, non-gumming, non-staining, easy removability, compatibility with the fibers knitted. A major group of points to be lubricated includes such parts as sinkers, jacks, dividers, camrollers, narrowing heads, spindles, slevage attachments, slur cam boxes and guide bars, and interrelated parts. To secure the necessary lubrication quality for this somewhat heavier service, an oil of heavier body, of about 250″to 300″ SUV at 100 F., has been found to provide the most satisfactory service. Circular knitting machines are of a much less complex design, but are nonetheless exacting in their requirements with respect to prevention of rust and stain. General guide for lubrication of knitting machines is given in tabular form.

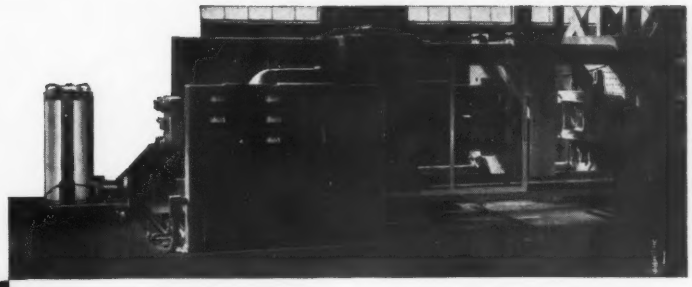
PATENT ABSTRACTS

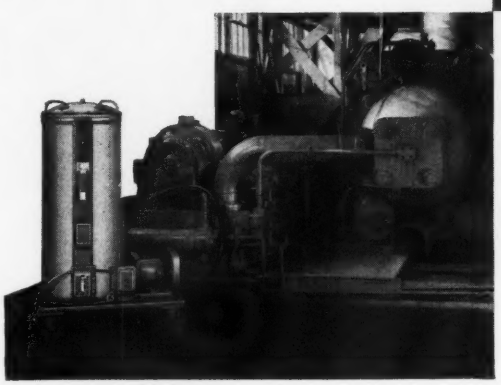
(*Continued from page* 300)

Extreme Pressure Lubricant Containing Manganese Naphthenate as an Antirust Agent —Patent #2,562,829—Lorne W. Sproule and Laurence F. King, assignors to Standard Oil Development Co.

An extreme pressure lubricating composition consisting essentially of about 80 to 82.5% by weight of mineral base lubricating oil, about 10% of sulfurized and phosphorus sulfide treated fatty oil, about 5% chlorinated hydrocarbon of about 40% chlorine content, said hydrocarbon being at least as high an average molecular

world's largest injection molding press





● This 69-ton, 300-ounce Watson-Stillman press accommodates dies up to 72" x 48". One of 14 injection molding machines at Amos Molded Plastics, Edinburg, Indiana, it employs a 7½-ton, 550 gallon hydraulic oil pumping unit (shown above being serviced by Honan-Crane Oil Purifier). Hydraulic equipment at Amos Plastics has been protected by Honan-Crane Purifiers since 1942.

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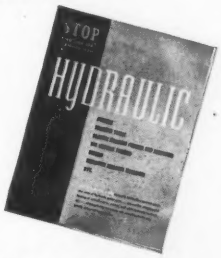

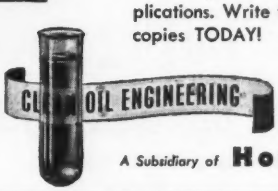

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weight as kerosene, and 2.5 to 5% of manganese naphthenate.

Soluble Metalworking Lubricant — Patent #2,562,844 — Denham Harman, Roy E. Thorpe, and Samuel K. Talley, assignors to Shell Development Co.

A cooling and lubricating composition comprising a major amount of an aqueous medium, a minor amount, sufficient to impart extreme pressure properties to the composition of a bis (hydroxy alkyl) sulfide and a corrosion inhibiting amount of a nitrite salt of an organic nitrogen base.

Anticorrosion Composition — Patent #2,562,845 — Thomas E. Reamer, assignor to Shell Development Co.

A non-aqueous oil composition which comprises a hydrocarbon oil and a minor but effective corrosion-inhibiting amount of an unsubstituted alkylated fused-polycyclic sulfonate consisting essentially of a tetralin nucleus and, attached to said nucleus, 1 alkyl radical of from about 18 to about 30 carbon atoms and from 1 to 3, inclusive, metallic sulfonate groups.

Lubricating Oil Composition—Patent #2,562,904—Michael W. Freeman.

A lubricating liquid vehicle having incorporated therein a homogeneous product in amount of from about 0.1% to about 25% of (a) 10 to 75 moles of a reaction product obtained by reacting from about 1 to 5 moles of an amine with about 1 mole of a higher fatty acid with (b) 90 to 25 moles of an oxidized-phosphorized-sulfurized organic body selected from the group consisting of petroleum sulfonates and sulfonated castor oil, the oxidation being produced by treatment with an oxidizing agent at a temperature of from 200 F. to 500 F. until at least 1% of combined oxygen is present, and the phosphorization and sulphurization being produced by up to 50% by weight on the product subjected to phosphorization and sulphurization of a phosphorus sulfide at a temperature of from about 150 F. to 500 F., said reaction products (a) and (b) coreacted until a homogeneous product is obtained.

Preparation of Lubricating Compositions—Patent #2,563,013—Marshall Duke, Joseph Rio and Conrad Hohing, Jr., assignors to Celanese Corporation of America.

In a process for preparing lubricating compositions containing a lubricant selected from the class consisting of mineral, animal and vegetable oils and dehydrated and desalted sulfonated fatty materials from sulfonated fatty materials containing water and inorganic salts, the steps which comprise distilling the water from the sulfonated fatty materials with the lubricant whereby the inorganic salts are precipitated, and separating the inorganic salts from the lubricating composition so formed.

Soluble Cutting Oils—Patent #2,563,588—Thomas Walton Dixon, assignor to Standard Oil Development Co.

A soluble cutting oil consisting essentially of 10 to 50% petroleum sulfonate, 2 to 15% rosin soap, 20 to 70% mineral oil, 1 to 5% of C_2 to C_4 mono-alkyl ether of glycol as a mutual solvent, 0.01 to 0.1% of a silicone polymer and 0.005 to 0.2% of an amine selected from the group which consists of lower alkylol amines, phenyl amines and cyclohexyl amines, a modifier for dispersing said silicone polymer in said oil.

Distillation of Acid-Treated Oils—Patent #2,563,605—Minor C. K. Jones and Edward C. Eulhardt, assignors to Standard Oil Development Co.

In a process in which an acid-treated mineral oil containing acid esters is distilled the improvement which comprises adding to the said oil during distillation somewhat less than 100% of the amount of alkali required to theoretically fully neutralize the said acid esters together with a small quantity of petroleum phenols.

Grease Containing Silica Gel Treated with a Polyhydric Alcohol—Patent #2,563,60€—Charles N. Kimberlin, Jr. and Augustus B. Small, assignors to Standard Oil Development Co.

A lubricating grease composition capable of resisting the solvent action of low boiling hydrocarbons, consisting essentially of an inorganic hydrogel, the water of which has been substantially replaced by a polyhydric alcohol selected from the group consisting of glycerol and the monomeric and polymeric ethylene and propylene glycols.

Lubricating Oil Additives — Patent #2,563,609—Alfred H. Matuszak, assignor to Standard Oil Development Co.

A mineral lubricating oil containing dissolved therein 0.1% to 10% of pentaerythritol mono-oleate mono-allylcarbonate.

Grease Composition—Patent #2,564,561—Emmett S. Carmichael and Eldon L. Armstrong, assignors to Socony-Vacuum Oil Co., Inc.

An improved barium-base grease composition characterized by stability at temperatures in excess of 200 F., comprising lubricating oil and a sufficient proportion of the barium soaps of fatty acids to characterize the grease as one having a barium base and, in addition thereto, a small proportion sufficient to stabilize the grease of the barium salt of a mono-basic fatty acid having not more than 6 carbon atoms.

Yarn Lubricant — Patent #2,564,768 — George W. Seymour and Fred Fortess and Marshall Duke, assignors to Celanese Corporation of America.

A lubricating and conditioning composition for the treatment of textile materials to render the same more amenable to textile operations, comprising a mixture of about 55 parts by weight of a mineral oil, about 5 to about 12.5 parts by weight of castor oil, 1.5 to about 5 parts by weight of an alkylolamine, about 5 to about 10 parts by weight of a long chain aliphatic acid, about 5 parts by weight of an alkyl phenol and a blending agent selected from the group consisting of oleyl alcohol and diglycol laurate, said mixture containing 0.01 to about 0.1 part by weight of said mixture of the desalted and dehydrated reaction product of oleum with a mixture of a long chain aliphatic acid, a vegetable oil and mineral oil neutralized with an alkali and an alkylolamine.

(*Continued on page* 305)

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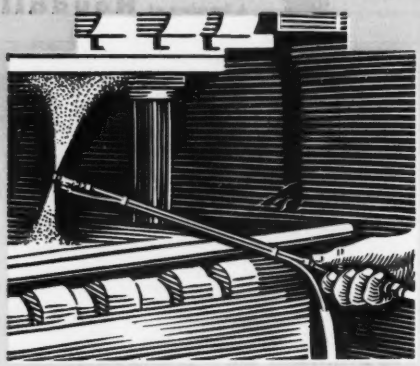

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(*Continued from page* 303)

Textile Oils—Patent #2,565,403—Lorne W. Sproule and Thomas W. Dixon, assignors to Standard Oil Development Co.

A textile oil composition consisting essentially of 76 to 94.4% by weight of a mineral base oil of 50 to 200 SSU viscosity at 100 F., 5 to 20% of sodium sulfonate having a molecular weight between 380 and 480, 0.5 to 2.5% of polyoxyalkylene derivative of sorbitan mono-oleate, and 0.1 to 1.5% of sorbitan mono-oleate.

Production of Lubricating Grease—Patent #2,565,981—Arnold J. Morway, Hollis L. Leland and Gordon W. Duncan, assignors to Standard Oil Development Co.

The process of preparing lubricating grease containing an alkali metal salt of a low molecular weight monocarboxylic acid which comprises the steps of adding 0.1 to 8% by weight, based on the final composition of a C_1 to C_4 aliphatic alcohol ester of said monocarboxylic acid to a hydrocarbon lubricating oil and 5 to 30% of a saponifiable fatty material, thereafter adding saponifying agent at an elevated temperature of 150 F. to 200 F., in quantity sufficient to substantially hydrolyze and neutralize said ester and said fatty material, and finally cooking the ingredients to evaporate water and other volatile ingredients and to form a grease structure.

Triple Ether Lubricant—Patent #2,566,157—George E. Barker, assignor to Elgin National Watch Co.

A lubricant having as the dominant and major ingredient thereof mixed partially isomeric triple ethers of the general formula A—S—B—O—B^1—S—A^1 where A,B,A^1 and B^1 are saturated aliphatic groups, each containing 2 to 18 carbon atoms, S represents a sulfur ether linkage, and O represents an oxygen ether linkage; the total number of carbon atoms being from 10 to about 32, a resin selected from the group consisting of polystyrene and acrylic resins having a molecular weight of 20,000 to 100,000; and, also, including an aralkyl ester ingredient intersoluble with said ether and a solvent of said resin, said ester ingredient being a mixture of siomers each having alkyl structures of 10 to 24 carbon atoms, the amount of said ester ingredient being less than the amount of ether ingredient and characterized in having a pour point not higher than minus 80 F. and a cloud point not higher than 20 F., the amount of resin being 1½ to 4½ parts per 100 parts of the ether and ester ingredients combined.

Lubricants for Steam Turbines — Patent #2,566,289—Robert G. Mastin, assignor to Cities Service Oil Co.

A lubricant comprising a major proportion of a mineral oil of lubricating viscosity, and a minor proportion, sufficient to improve the properties of the oil as regards oxidation, of p-methoxy-benzyl-m-toluidine.

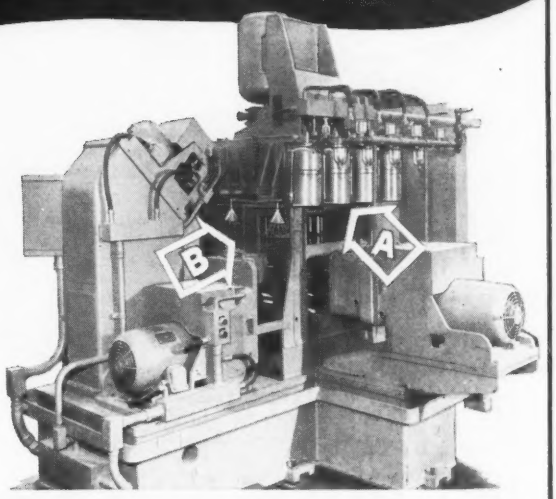
From Official Gazette—Vol. 650, Nos. 1, 2, 3, 4. Vol. 651, Nos, 1, 2, 3, 4, 5.

Hardening and Decolorizing Glyceride Oils with Nickel-Alumina-Silica Catalysts—Patent #2,566,362—Wm. J. Paterson, assignor to Lever Brothers Co.

A process for hydrogenating and decolorizing refined, dark-colored glyceride oils to form edible products having a minimum of unsaponifiable components and having acceptable improved color and stability, which comprises treating the oil at a temperature in the range of 100 to 200 C. with hydrogen at a presesure in the range of 1 to 3 atmospheres absolute, in the presence of a non-colloidal, particulate, nickel-alumina-silica catalyst containing an amount of nickel in the range of 15.0 to 50.0% and an equivalent alumina and silica content in the range of 4.0 to 16.0 $A1_2O_3$ formula weights per 45 SiO_2 formula weights, obtained by reducing a coprecipitated precursor, the amount of catalyst used being such as to contain an amount of nickel in the range of 0.02 to 0.30% Ni based on the weight of the oil, said catalyst being readily and substantially completely removable from the hydrogenated and decolorized oil by filtration.

Norgren OIL-FOG Lubricates 51 Taps

Cuts Tap Breakage – Improves Tap Hole



NOTE

(A) Bank of four Norgren Lubro-Control Units — filter, pressure regulator & 1¾ gal. lubricator.

(B) Aerosol distributors and tubes to each tap — other distributors not shown.

This SNYDER TOOL & ENGINEERING CO. (Detroit) machine taps 51 holes in right and left bank plus top and rear face of automobile engine blocks — replacing four machines formerly required.

Each tap is cleaned, cooled, and lubricated with Norgren Lubro-Control Units — resulting in improved tap holes and pronounced drop in back-tap breakage. As heads move in for tapping, solenoid valves open the oil-fog system for 2 or 3 seconds, playing the right amount of OIL FOG on every tap. A big improvement over centralized lubrication or coolant systems, say the machine builders.

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Lubricants and Lubricant Additives—Patent #2,566,397—John D. Bartleson and Herman P. Lankelma, assignors to The Standard Oil Co.

A lubricant comprising a mineral lubricating oil and an amount sufficient to inhibit the oxidative deterioration in use of the oil of an oil-dispersible product of the reaction at 350 F. for eight hours of 1.15 moles ethyl mercaptan to each mole of a reaction product of 1 mole of phosphorus pentasulfide and 1.5 moles of "reduced motor polymer" reacted together at 350 F. for eight hours to produce an oil-dispersible material suitable for improving the characteristics of a mineral lubricating oil.

Lubricants and Lubricant Additives—Patent #2,566,398—John D. Bartleson and Herman P. Lankelma, assignors to the Standard Oil Co.

A lubricant comprising a mineral and lubricating oil and an amount sufficient to inhibit the oxidative deterioration in use of the oil of an oil-dispersible product of the reaction at 350 F. for eight hours of 1.15 moles ethyl alcohol to each mole of a reaction product of 1 mole of phosphorus pentasulfide and 1.5 moles of "reduced motor polymer" reacted together at 350 F. for eight hours to produce an oil-dispersible material suitable for improving the characteristics of a mineral lubricating oil.

Solid Essential Oil Concentrate and Process of Preparing the Same—Patent #2,566,410—Wm. C. Griffin, assignor to Atlas Powder Co.

A composition comprising a solid sol wherein the continuous phase consists essentially of sorbitol and the disperse phase is an essential oil.

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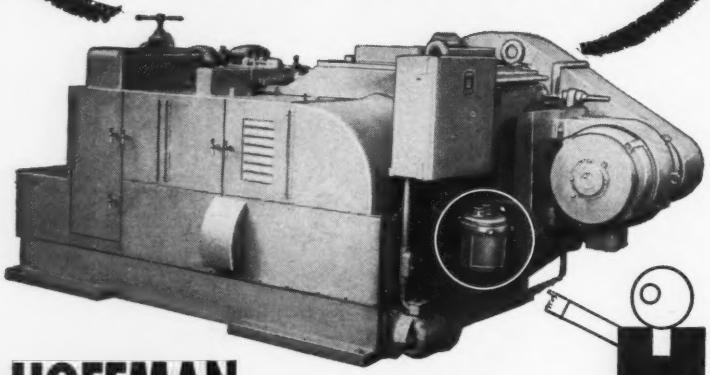

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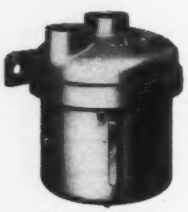

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The I-4-15D

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Additives for Hydrocarbon Oils—Patent #2,572,000—John D. Bartleson, assignor to The Standard Oil Co.

A concentrate suitable as an anti-oxidant and anti-sludge additive for mineral lubricating oils, comprising a mineral oil and a reaction product of ammonia with P_4X_8, wherein X stands for a member of the sulfur family, said reaction product being obtained by dispersing in the oil an amount up to about 50% of said phosphorus compound by weight of the oil and then blowing ammonia gas through the oil.

Mineral Oil Compositions Containing the Reaction Product of Polystyrene and an Alkyl Ester of an Unsaturated Acid—Patent #2,572,557—John Mann Butler, assignor to Monsanto Chemical Co.

A composition of matter which comprises a liquid petroleum fraction and from 0.2 to 6 per cent by weight, based on the petroleum fraction, of a polystyrene substituted by reaction with an ester having the structural formula:

$$R'—O—\overset{\overset{O}{\|}}{C}—R$$

wherein R′ is an alkyl radical having from one to 20 carbon atoms and R is a mono olefinic hydrocarbon radical of 9 to 10 carbon atoms having only single bonds attached to the carbon atoms adjacent the carbonyl radical, said substitution being effected on the benzene nucleus of the polystyrene through the olefinic group of the said ester.

Mineral Oil Containing Alkylated Polystyrene — Patent #2,572,558 — John Mann Butler, assignor to Monsanto Chemical Co.

A petroleum product having an improved viscosity characteristic which comprises a petroleum oil fraction and from 0.2 to 6 per cent by weight, based on the oil, of a polystyrene having an average of in excess of 1.5 isopropyl principal substituent per styrene unit, said polystyrene having an average molecular weight in excess of 20,000.

Method of Improving Lubricating Oil by Absorption on Silica Gel—Patent #2,572,866 —Insley P. Jones, assignor to Standard Oil Development Co.

A silica gel lubricating oil treating process in which lubricating oil diluted from a paraffinic hydrocarbon containing from about 3 to 10 carbon atoms and boiling in the range of about 100 F. to 300 F. is substantially adsorbed on silica gel by contact therewith, subsequent to said contacting washing the silica gel and adsorbed oil components with said paraffinic hydrocarbon whereby paraffinic and naphthenic constituents of high viscosity index are desorbed from the silica gel, fractionating high viscosity index constituents from the wash paraffinic hydrocarbon by distillation removing the said paraffinic hydrocarbon as an overhead product, and thereafter recycling said overhead product to the said silica gel contacting the silica get in liquid phase at about the boiling point of the paraffinic hydrocarbon, whereby the said silica gel is regenerated.

Lubricant Composition Containing Dialkyl Trihaloalkane Phosphonate as an Extreme Pressure Agent—Patent #2,573,568—Denham Harman and Roy E. Thorpe, assignors to Shell Development Co.

A composition of matter comprising a major amount of a neutral liquid medium and a minor amount, sufficient to impart extreme pressure properties to said neutral liquid medium, of a dialkyl trihaloalkane phosphonate.

Water-Resistant Greases—Patent #2,573,650—Walter H. Peterson, assignor to Shell Development Co.

A grease composition comprising a lubricating oil, 1 to 20% based on said oil of an inorganic gel, said gel retaining in the composition the gel structure substantially as originally formed, and 0.5 to 40% by weight of said gel of a non-metallic hydrophobic aliphatic hydroxy organic compound having at least 8 carbon atoms.

Process for Breaking Water and Oil Emulsions—Patent #2,566,979—Arthur E. Catanach and Ralph P. Gulley, assignors to Gulf Oil Corp.

The process of breaking stable oil-water emulsions containing a relatively large proportion of inorganic salts, said process comprising adding thereto spent refinery caustic solution which has been pretreated by simultaneously blowing steam and air therethrough for several hours at a temperature of above about 160 F., agitating and heating the mixture thus formed until the emulsion will break into separate oil and water phases after a short settling period, discontinuing agitation and heating, and allowing the mixture to settle into separate oil and water layers.

Process of Breaking Water and Oil Emulsions—Patent #2,566,980—Arthur E. Catanach and Ralph P. Gulley, assignors to Gulf Oil Corp.

The process of breaking oil and water emulsions which comprises heating the emulsion, adjusting the pH of the water contained in the emulsion to a value between 11 and 13, agitating and heating the emulsion thus formed until the emulsion will break into separate oil and water phases after a short settling period, discontinuing agitating and heating, and allowing the mixture to settle into separate oil and water layers.

Oil Compositions Containing Amine Salts of Acid Compounds of Boric Acid and Hydroxy Carboxylic Acids — Patent #2,568,472—Charles E. Trautman, assignor to Gulf Research & Development Co.

A composition of matter comprising a major proportion of a hydrocarbon oil and a minor proportion of an amine salt of an acid compound of boric acid and a hydroxy carboxylic acid in which the hydroxyl group and the carboxylic acid group are separated by no more than two carbon atoms, said amine salt being present in an amount ranging from about 0.001 per cent by weight to the limit of its solubility in said oil.

Method for Solubilizing at Least Partially Insoluble and Gelatinized Oils — Patent #2,568,551—Max Kronstein.

A method of solubilizing an at least partially insoluble oil selected from the group consisting of fixed oils and synthetically produced oils containing a higher fatty acid ester of a polyhydric alcohol having more than two hydroxy groups which comprises melting and compounding with said oil a compound comprising a metal soap of a higher fatty acid ester of an alcohol having from one to two hydroxy groups at a melting temperature below the decomposition temperature of the resulting composition and at such melting temperature that substantially the entire mass of the resulting composition is melted into the liquid stage, whereby to form a soluble oil reaction product capable of forming a stable solution.

Method of Separating Impurities From Used Lubricating Oils—Patent #2,568,583 —Eldon F. Graves, assignor to The Dow Chemical Co.

A method of separating dispersed impurities from used lubricating oil which comprises dissolving in the oil a minor but effective proportion of an N-phenyl alkylol amine selected from the group consisting of N-phenyl ethanolamine, N-phenyl diethanolamine, and N-phenyl ethanolisopropanolamine sufficient to cause aggregation of the impurities and thereafter separating the aggregate of impurities from the oil.

Coal Acid Esters as Synthetic Lubricants —Patent #2,568,965—Charles W. Montgomery and Wm. I. Gilbert and Robert E. Kline, assignors to Gulf Research & Development Co.

1. A process of reducing the coefficient of friction between metal surfaces moving in contact with and relative to each other which comprises lubricating said surfaces by a film of a substantially neutral ester of a monohydric alcohol and the mixture of aromatic acids obtained by the oxidation with gaseous oxygen at a temperature from about 200 C. to about 300 C. and at a pressure from about 500 to about 1200 pounds per square inch of an aqueous alkaline slurry of a finely divided carbonaceous material selected from the group consisting of coal and coke obtained by the carbonization of coal at temperatures below 700 C., the acidification of the resulting alkaline solution to liberate said acids and the extraction of said acids with an organic water-immiscible solvent which will remove the acids.

10. A lubricant composition comprising a major amount of a mineral lubricating oil and a minor amount, at least sufficient to retard rusting, of a substantially neutral ester of a monohydric alcohol and the mixture of aromatic acids obtained by the oxidation with gaseous oxygen at a temperature from about 200 to about 300 C. and at a pressure front about 500 to about 1200 pounds per square inch of an aqueous alkaline slurry of a finely divided carbonaceous material selected from the group consisting of coal and coke obtained by the carbonization of coal at temperatures below 700 C., the acidification of the resulting alkaline solution to liberate said acids and the extraction of said acids with an organic water-immiscible solvent which will remove the acids.

Lubricant—Patent #2,569,122—David E. Adelson, assignor to Shell Development Co.

A lubricant comprising a major amount of a mineral oil and a minor amount, sufficient to impart extreme pressure properties to said mineral oil, of a reaction product obtained by reacting an unsaturated organic compound selected from the group consisting of unsaturated cyclic ketone fractions containing at least 12 carbon atoms and monoolefinic aliphatic hydrocarbons containing at least 8 carbon atoms, with a polychlorinated saturated organic compound selected from the group consisting of polychlorinated hydrocarbons of from 1 to 2 carbon atoms and polychlorinated fatty acids of not more than 6 carbon atoms having at least 2 chlorine atoms which are separated from the carboxyl group of said acids by not more than 2 carbon atoms, in the mole ratio of from 1:1 to 1:4 respectively, in the presence of a peroxide catalyst under reflux conditions, and further treating said reaction product with hydrogen sulfide-ammonium hydrosulfide at above room temperature until saturated.

Mineral Oil Compositions Containing Esters of Reaction Product of Maleic Anhydride and Styrene—Patent #2,570,846— Ferdinand P. Otto and Orland M. Reiff and Robert W. Barrett, assignors to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing a minor proportion, sufficient to lower the pour point thereof, of the product obtained by reacting about 6 parts by weight of maleic anhydride with about 5 parts by weight of styrene to produce a copolymer, and then esterifying said copolymer with a mixture of saturated aliphatic alcohols having an average of about 14 carbon atoms per molecule in a straight chain.

Thiophenethiol-Phosphorus Halide Reaction Products in Lubricating Compositions —Patent #2,571,332—John W. Brooks, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing a small proportion, sufficient to stabilize said oil against oxidation of a reaction product obtained by reacting from about 1 mol to about 3 mols of a thiophenethiol with 1 mol of a phosphorus halide, at temperatures of from about 15 C. to about 150 C.

Seperation of Oil From Wax—Patent #2,571,752—Walter V. Overbaugh, assignor to The Texas Company.

In the separation of oil from a feed mixture of relatively low viscosity oil and wax by crystallization of wax, and filtration in the presence of a solvent liquid, said feed mixture being of such character that a wax cake comprising wax crystals of voluminous character and of relatively high oil content normally is formed, the improvement which comprises effecting said crystallization in the presence of a minor proportion of added and substantially wax-free lubricating oil of relatively more viscous character than the oil present in said feed mixture and effective to reduce wax crystal size such that said wax cake is of relatively lower oil content than that obtained by crystallization in the absence of said added oil.

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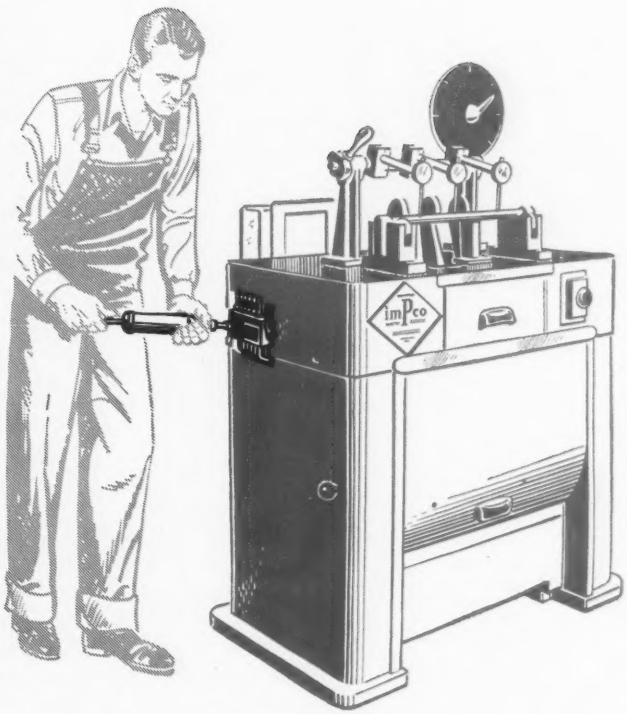

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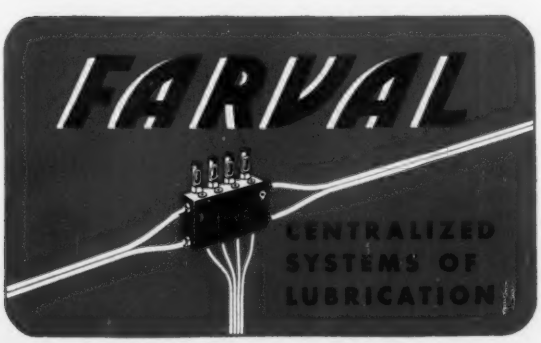

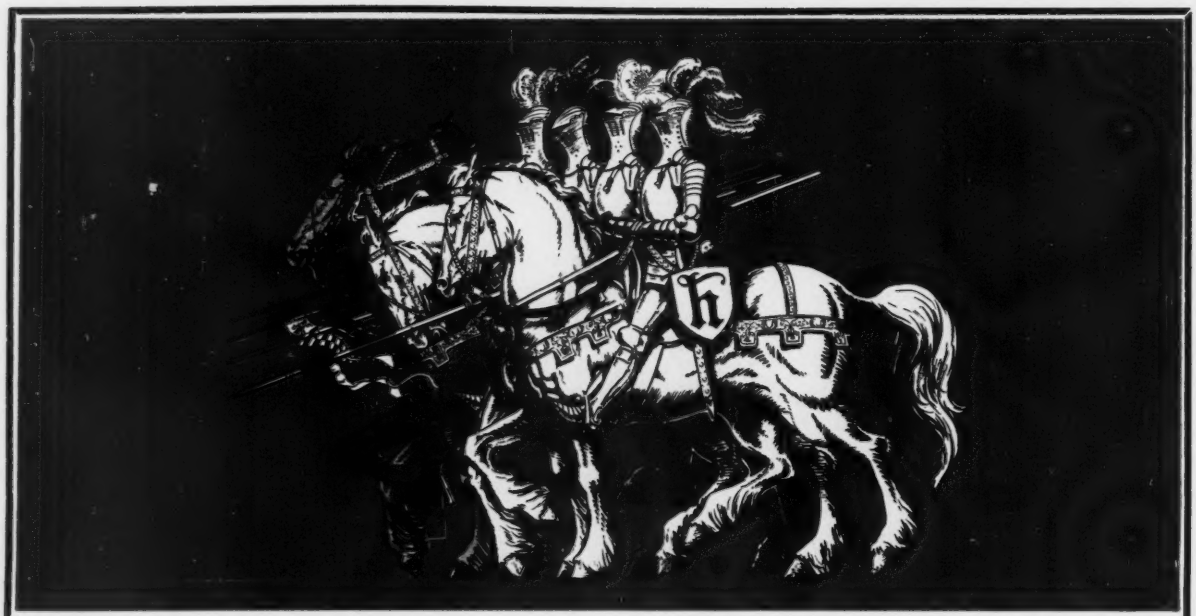

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